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**LICHENES A W. A. SETCHELL ET H. E. PARKS
IN INSULA TAHITI A 1922 COLLECTI**

**SCRIPSIT
EDV. A. VAINIO**

UNIVERSITY OF CALIFORNIA PUBLICATIONS IN BOTANY

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LICHENES A W. A. SETCHELL ET H. E. PARKS IN INSULA TAHITI A 1922 COLLECTI

SCRIPSIT

EDV. A. VAINIO

***Eumitria trullifera* (Nyl.) Vain.**

Usnea trullifera Nyl. in Cromb. Lich. Chall. Exp., p. 224.

In arboribus prope Diadem (5236 p.p.) et flumen Punaruu (5140 p.p.).

f. *praelongata* Vain.

Thallo longiore, demum subpendulo. Prope fl. Punaruu. (5140 p.p.)

***Usnea diademensis* Vain. sp. nov.**

Thallus erectus, apices versus leviter verruculosus, ceterum laevigatus, sorediis et spinulis destitutus, strato medullari crebro, KHO lutescente deindeque rubescente. Apothecia lat. 1.5–8 mm., subtus laevigata, margine parce spinuloso-ramuloso. Ab *U. jamaicensi* Ach. thallo minus verruculoso differt. Corticola prope montem Diadem (2600 ped. s. m.) (5237).

***Usnea fautauensis* Vain. sp. nov.**

Thallus suberectus, soraliis praesertim elongatis, angustis, partim confluentibus, parcius rotundatis, sorediis passim in spinulas brevissimas excrescentibus, ramis adventitiis tenuibus, spinaeformibus, passim abundantibus crebrisque instructus, ceterum sat laevigatus, strato medullari sat laxo, KHO lutescente deindeque fulvescente. *Eumitria Baileyi* Stirt. jam axi cavo ab hac specie et *U. rigida* Vain. (quacum a Zahlbr. in Ergeb. Exp. Südbras. p. 191 commixta est) facile distinguitur. Corticola in valle Fautaua (5445).

***Usnea nidifica* Tayl.**

Lond. Journ. Bot. 1847, p. 191, sec. specim. orig. in herb. Nyl.

Thallo pallido, laevigato, apicem versus parce soredioso, pendulo, axi tenui, strato medullari laxo, KHO rubescente.

Usnea nidifica f. straminea Vain.

Thallo stramineo differens, in arboribus prope flumen Punaruu (5145).

Usnea societatis Vain. sp. nov.

Thallus pendulus, stramineus, basi crass. 1-1.5 mm., laevigatus, apicem versus bene sorediosus, jodo non reagens, strato medullari crebro, KHO lutescente deindeque rubescente. In arboribus prope flumen Punaruu (5141).

Ramalina Roesleri Hochst.

In Arn. Lich. Exs. (1897) n. 1721.

Thallus compressus, stramineus, soraliis minutissimis instructus. Proxime affinis *R. taitensi* Nyl. (Rec. Mon. Ram., p. 21), quae thallo pallido, albostriato, verruculoso ab ea differt. Corticola in valle Fautaua (5444) et in palude Purau prope Maraa (5400 p.p.). Specimen posterius in *R. taitensem* fere transit.

var. **isidiotyla** Vain.

Thallus sorediis isidioides (fere sicut in *R. sorediella*). In arboribus prope flumen Punaruu (5144).

Ramalina thraustoides Vain. sp. nov.

Thallus dichotome ramosus, compressus, stramineus, KHO non reagens, basi lat. 0.7 mm., soraliis ellipsoideis oblongisque marginalibus, apicibus sensim attenuatis. Subsimilis *R. subasperatae* Nyl. et *R. flagelliferae* Vain., a quibus soraliis differt. In palude Purau corticola (5400 p.p.).

Ramalina canaliculata Tayl.

Prope flumen Punaruu corticola (5143, 5384).

Parmelia latissima Fée var. **cristifera** (Tayl.) Hue

In arboribus prope flumen Punaruu (5146, 5386).

Parmelia saccatiloba Tayl.

In valle Maara (5319).

***Parmelia coralloidea* (Mey. et Flot.) Vain.**

Lich. Bras. Exs. n. 537, cet.

Ad corticem arborum in palude Purau (5399).

***Parmelia Setchellii* Vain. sp. nov.**

Thallus laciniis circ. 7–10 mm. latis, lobis apicalibus circ. 3–5 mm. latis, superne caesio-glauescens, opacus, medio et ad margines elevatos et simul revolutos isidioideo-verruculosus, verruculis p.p. sorediosofatiscentibus, subtus nigricans et ad ambitum anguste pallidus, papillis crebris et rhizinis sat parcis brevibus instructus et ad ambitum haud late laevigatus, KHO superne et intus lutescens. addito CaCl_2O_2 intus leviter rubescens. Affinis est *P. caperatae* Ach. Ad corticem arboris in valle Punaruu (5387).

***Pertusaria hypochrysea* Vain. sp. nov.**

Thallus modice incrassatus aut sat tenuis, continuus, sat laevigatus, albidus aut glaucescenti-albidus, subtus intusque maculis ochraceis, KHO purpurascentibus, ceterum KHO intus lutescens. Pseudostromata sat crebra, irregulariter subglobosa, basi demum contracta, lat. circ. 0.6–1.3 mm., verruculoso-inaequalia, KHO intus lutescentia, maculis ochraceis KHO purpurascentibus (hymeniis haud evolutis). Ad stirpem *P. tuberculiferae* Nyl. pertinet. Ad corticem arborum in valle Punaruu (5381) et in palude Purau (5406).

***Anaptychia leucomelaena* (L.) Vain.**

Ad truncos arborum in valle Maara (5321).

***Anaptychia hypoleuca* (Mühlenb.) Vain.**

**A. dendritica* (Pers.) Vain. (Ét. Lich. Bres. I, p. 134).

Supra muscos in valle Maara (5320).

***Physcia integrata* Nyl. var. *obsessa* (Mont.) Vain. f. *subalba* Vain.**

Addit. Lich. Antill., p. 65.

Ad corticem arboris in palude Purau (5405).

***Physcia crispa* (Pers.) Nyl. var. *mollescens* (Nyl.) Vain.**

Ad corticem arboris in valle Punaruu (5383).

Physcia picta (Sw.) Nyl.

Ad corticem arboris prope isthmum Taravao in ditione Hitiaa (5333).

Pyxine chrysantha (Müll. Arg.) Vain.

Catal. Welw. Afr. Pl. Lich., p. 412.

Sicut praecedens (5332).

Sticta lobariaeformis Vain. sp. nov.

Thallus irregulariter laciniatus sinuosusque, ramificatione similis thallo *St. sinuosae* Pers., sed angustior tenuiorque. Apothecia minora (lat. 1–1.5 mm.), supra thallum sparsa, numerosa. Thallus superne glaucescens, subnitidus, subtus obscuratus, cyphellis sat crebris, 0.2–0.7 mm. latis, rhizinis brevibus, crebris, obscuratis, nec KHO nec CaCl_2O_2 reagens. Gonidia pleurococcoidea. Ad corticem arboris in valle Maara (5421).

Pseudocyphellaria crocata (De Not.) Vain.

In valle Fautaua (5442).

Pseudocyphellaria carpoloma (Del.) Vain.

In valle Maara (5318).

Pseudocyphellaria amphistictoides Vain. sp. nov.

Thallus superne glaucescenti- et fuscopallescenti-variegatus, concavus, inferne pallidus, late glaber, laciniis circ. 10–1.5 mm. latis, margine parcissime isidioso et abundanter pseudocyphellato aut sub-soredioso, lobis nonnullis superne parce pseudocyphellatis, inferne pseudocyphellis crebris, albis, subprominentibus. Medulla alba, KHO non reagens. Rhizinae passim evolutae, breves, fusciscenti-pallidae cinerascencesve. *Ps. amphisticta* (Nyl.) pseudocyphellis impressis, cyphelloideis ab hac specie differt. In valle Fautaua (5443).

Pannaria Mariana (Fr.) Müll. Arg. var. **radiata** (Nyl.) Vain.

Ad corticem arborum in valle Orofere (5303) et in palude Purau (5408).

Pannaria stylophora Vain. var. **perconfluens** Vain.

Lich. Ins. Philipp. III, p. 10.

Ad corticem arboris in valle Fautaua (5446).

Pannaria lepidophora Vain. var. **lepidocheila** Vain.

Loc. cit., p. 12.

Ad corticem arboris prope Papenu (5356).

Coccocarpia pellita (Ach.) Vain.

Ad corticem arborum in vallibus Orofere (5305) et Fautaua (5449).

Coccocarpia cronia (Tuck.) Vain. var. **primaria** Vain.

Loc. cit., p. 23.

Ad corticem arboris in palude Purau (5411).

Leptogium moluccanum (Pers.) Vain. var. **mastocheila** Vain.

var. nov.

Margine apotheciorum cinereo-papillato a var. *hypotrachyna* Vain. (*loc. cit.*, p. 35) differt. Thallus crass. 0.060–0.080 mm. Ad corticem arborum in palude Purau (5410).

Leptogium laceratulum Nyl.

In Cromb. Lich. Chall. Exp., p. 224.

f. integrrior Vain.

Thallus margine integro. In valle Fautaua (5447). Specimen orig. in herb. Nyl. ad hanc formam pertinet, sed descriptio Nylanderiana ad f. *fibrillosam* Vain. spectare videtur. In speciminibus nostris apothecia habitu sicut in *L. moluccano* var. *hypoleia* Vain.

Leptogium laceratulum f. fibrillosa Vain.

Thallus margine denticulato et isidioideo-laceratulo. Ad corticem arborum in valle Orofere (5304) ster. et prope isthmum Taravao in ditioe Hitiaa (5335) fert.

Leptogium phyllocarpum (Pers.) Nyl. var. **macrocarpa** Nyl.

Ad corticem arborum in valle Fautaua (5343) et prope Papenu (5357).

Physma byrsinum (Ach.) Müll. Arg. var. **plumbea** (Schaer.) Vain.

Ad corticem arborum in valle Maara (5371, 5420).

var. hypomelaena Nyl.

Ad corticem arboris in valle Maara (5419).

Collema thysanaeopsis Vain. sp. nov.

Subsimilis *C. thysanaeodi* Nyl., quae apotheciis minoribus, sporis subacicularibus et thallo tenuiore, jodo rubescente, ab eo differt. Thallus mucosus, jodo non reagens, crass. 0.050–0.055 (–0.060) mm., increbre foveolatus (impresso-punctatus), subtus infra apothecia strato grosse parenchymatico 0.080–0.090 mm. crasso instructus. Apothecia marginalia, lat. 1–2.8 mm., disco rufo fuscescenteve, margine thallino, integro. Amphithecium thallinum, strato corticali destitutum. Parathecium circ. 0.016 mm. crassum, plectenparenchymaticum, cellulis sat parvis. Perithecium infra hypothecium situm tenue evanescensve. Sporae fusiformes, 5-septatae, long. 0.038–0.052 mm., crass. 0.006–0.007 mm. Ad corticem arboris prope isthmum Taravao in ditione Hitiaa (5336).

Cladonia pityrea (Floerk.) Fr.

Ad terram et plantas destructas in valle Maara (5322) et ad viam Port-Phaeton in ditione Papeari (5205) et in isthmo Taravao in ditione Hitiaa (5337).

Bacidia melancheiloides Vain. sp. nov.

Thallus verruculis minutissimis (circ. 0.1 mm. latis), vulgo contiguus, granulis soredioides parce immixtis, tenuis aut sat tenuis, glaucus, hypothallo indistincto. Apothecia sat crebra, lat. 0.2–0.35 mm., adnata, basi constricta, disco plano, pallido aut raro demum obscurato, margine tenui, vulgo prominente, integro, nigro aut cinereo-nigricante, opaco. Hymenium 0.050–0.065 mm. crassum, decoloratum, jodo caerulescens. Hypothecium purpureum aut purpureo-fuligineum, KHO pulchrius violascens. Perithecium intus purpureo-fuligineum, extus decoloratum. Paraphyses sat arcte cohaerentes, simplices, haud gelatinosae. Sporae 8-nae, aciculares, rectae, pauci-septatae, long. 0.020–0.036, crass. 0.0015–0.002 mm. Conidangia vertice dilute subfuscenti-pallida, ceterum decolorata. Sterigmata simplicia, long. 0.016–0.012, crass. 0.0015 mm. Conidia filiformia, curvata, long. 0.012–0.014, crass. 0.0005 mm. Gonidia globosa aut subglobosa, diam. 0.004–0.008 mm., simplicia aut saepe demum glomerulosa, membrana

sat tenui. Affinis *L. leucothalamiae* Nyl. et *L. melacheilae* Nyl. (rectius *melancheila*), quae apotheciis majoribus et colore thalli ab ea differunt. Ad corticem arboris prope paludem Purau (5409).

***Sporopodium ochraceoluteum* Vain. sp. nov.**

Thallus continuus, verrucoso-inaequalis, albido-glauescens, KHO lutescens. Apothecia lat. 0.8–1.3 mm., basi constricta, disco plano, lutescenti-pruinoso, margine prominente, modice incrassato, fulvo, KHO simul solutionem violascentem et cyanescentem effundente. Epithecium KHO violascens. Paraphyses laxae cohaerentes, simplices. Sporae solitariae, murali-divisae, saepe demum fulvescentes et KHO violascentes, long. 0.051–0.070, crass. 0.016–0.022 mm. Praesertim reactionibus a *Sp. subvulpino* (Nyl.) Vain. differt. Ad corticem arboris in valle Fautaua (5344).

***Sporopodium glaucinum* Vain.**

Lich. Ins. Philipp. III, p. 92.

Hypothecium fuscescens, KHO purpureum. Epithecium gonidia continens. Sporae singulae, decolores, murali-divisae, long. 0.075–0.092, crass. 0.012–0.016 mm. Conidangia subcylindrica, long. circ. 0.003–0.005, crass. 0.002 mm., albida, vertice fulvescente, KHO non reagente. Macroconidia (stylospora) ovoideae, decoloratae, simplices, long. 0.006, crass. 0.0025 mm. Thallus albido-glauescens, KHO non reagens, hypothallo indistincto. Supra folia *Inocarpi edulis* in valle Fautaua (5094).—Huic speciei proxime affine est *Sp. peribyssirum* (Nyl.) Vain., in epithecio item gonidia continens et hypothecio olivaceo-fuscescente instructum (sec. specim. orig.).

***Sporopodium inocarpi* Vain. sp. nov.**

Thallus tenuis, glaucescens, laevigatus. Apothecia lat. 0.7–0.9 mm., basi constricta, disco convexo aut primum planiusculo, testaceo-vel cinereo-rufescente, tenuiter pallido-pruinoso, opaco, margine tenui, pallido, integro, opaco, subpersistente, haud prominente. Hypothallus infra apothecium et pars inferior hypothecii medio cyanescentem, ceterum hypothecium inferne albidum et superne rufescens. Perithecium decoloratum aut extus pallidum, plectenparenchymaticum, leptodermaticum, 6–10 μ diam., parathecio tenui rufescente. Hymenium circ. 0.160 mm. crassum. Epithecium pallidum. Paraphyses sat parcae, increbre ramoso-connexae. Sporae 8-nae, distichae, saepe

pallidae, murali-divisae, cellulis numerosis, long. 0.033–0.050. crass. 0.013–0.015 mm. Gonidia globosa, simplicia, diam. 0.005–0.010 mm. Supra folia *Inocarpi edulis* prope flumen Papehue (5134).

Lecidea (Psora) purpurescens Vain. sp. nov.

Thallus squamulosus, squamulis 0.8–0.3 mm. longis, hypothallo adnatis, contiguis aut demum subimbricatis, planis, superne glaucis, leviter nitidis, KHO non reagentibus, incisus laciniatisque, laciniis 0.1–0.15 mm. latis, margine saepe demum parce isidiosus, isidiis cylindricis, brevissimis aut verruculaeformibus, simplicibus, hypothallo byssoideo laxaque contexto, fusco, bene evoluto, etiam zona 1 mm. lata thallum cingente. Apothecia 0.5–1 (–1.3) mm. lata, vulgo aggregata et tuberculoso-confluentia, basi bene constricta, disco rufo aut fusco- vel testaceo-rufescente, nudo, opaco, convexo aut primum plano, margine tenui, concolore obscurioreve, saepe demum excluso. Hypothecium fulvescens, KHO non reagens, hyphis erectis, sat pachydermaticis. Perithecium decoloratum aut extus partim rufescens (KHO subpurpureum). Hymenium parte superiore rufescens (KHO subpurpureum) aut partim pallidum decoloratumve, jodo caerulescens. Sporae 8:nae, distichae, decolores, simplices, oblongae, long. 0.008–0.013, crass. 0.002–0.0025 mm. Colore et reactione apotheciorum a *L. phaeoglauca* Vain. differt. *L. javanica* Schaer. thallo pallido, hypothallo parciissime evoluto sporis subglobosis et apotheciis KHO non reagentibus a planta nostra distinguitur. Ad corticem arboris in valle Punaruu (5380 p.p.).

Lecidea (Psora) societatis Vain. sp. nov.

Thallus squamulosus, squamis circ. 1–0.2 mm. longis, supra hypothallum album tennem dispersis aut subcontiguis, planis, glaucis, opacis, KHO non reagentibus, demum incisus laciniatisque, laciniis 0.2–0.15 mm. latis, haud isidiosus, hypothallo byssino, laxo contexto, tenui. Apothecia lat. 0.5–0.8 (–1.2) mm., solitaria aut parce aggregata, basi constricta, disco fusco- aut subcinereo-rufescente, nudo, opaco, depresso-convexo aut primum plano, margine pallido, tenui, integro, haud prominente, demum subexcluso. Hypothecium fulvo-rufescens, KHO non reagens, hyphis erectis, sat pachydermaticis. Perithecium extus subdecoloratum, intus fulvescens pallidumve. Epithecium decoloratum aut pallidum rufescensve, KHO non reagens. Hymenium jodo caerulescens. Sporae 8:nae, decoloratae, simplices,

ellipsoideae aut oblongae ovoideaeve, long. 0.005–0.007, crass. 0.0015–0.002 mm. Affinis *L. javanicae* Schaer., quae sporis subglobosis et thallo parce isidioso ab ea differt. Ad corticem arboris prope flumen Papehue (5349).

***Lecidea (Biatora) declinella* Vain.**

L. Jap. Cont. I (1921), p. 68.

Ad corticem arboris in valle Orofere (5308).—Sporae long. 0.014–0.019, crass. 0.007–0.008 mm.

***Pilocarpon leucoblepharum* (Nyl.) Vain.**

Etud. Lich. Brés. II (1890), p. 89.

Cum *Porina Mangiferae* in valle Fautaua (5091 p.p.), supra folia *Mangiferae*.

***Pilocarpon chlorinum* Vain. sp. nov.**

Thallus tenuissimus, viridis, continuus et granuloso-inaequalis aut e granulis minutissimis soredioides dispersis constans, hypothallo indistincto. Apothecia lat. 0.3–0.2 mm., tota adnata, basi haud constricta, sed basim versus sat abrupte dilatata, disco nigro, nudo, plano aut leviter subconvexo, margine sat tenui, persistente, haud prominente, albo, tomentoso. Perithecium ex hyphis formatum irregulariter contextis, haud conglomeratis. Hypothecium parte angusta superiore subcyanescenti-nigricans, ceterum subviolascenti-fuscescens. Epithecium pallidum aut decoloratum. Sporae 8-nae, distichae, decoloratae, oblongae, rectae aut rarius leviter curvatae, apicibus obtusis rotundatisve, 3-septatae, long. 0.010–0.012, crass. 0.002–0.0025 mm. Gonidia pleurococcoidea. Supra folia *Perseae gratissimae* in valle Fautaua (5096).

***Pilocarpon cateileum* Vain. sp. nov.**

Thallus tenuis, continuus aut raro subdispersus, stramineo-albicans, laevigatus, soraliis rotundatis, 0.7–0.2 mm. latis vulgo crebre inspersus, hypothallo concolore, tenuissimo, crebre contexto, partim subradiante, saepe cinctus. Apothecia lat. 0.4–0.9 mm., crass. circ. 0.210 mm., late adnata, basi constricta, disco testaceo-rufescente testaceove, nudo, opaco, plano, margine tenui, saepe demum subflexuoso, subintegro, albido, haud aut leviter prominente, glabro, persistente. Hypothecium rufescens aut pallido-rufescens, KHO non reagens, hyphis tenuibus, conglomeratis. Excipulum impellucidum,

albidum, gonidiis destitutum, hyphis 0.0015 mm. crassis, leptodermaticis, crebre irregulariter contextis, haud conglutinatis, parathecio rufescente albidove tenui evanescenteve. Hymenium 0.060–0.070 mm. crassum, jodo caerulescens. Epithecium pallidum aut stramineum aut decoloratum, granulosum, KHO non reagens. Paraphyses numerosae, flexuosae, ramoso-connexae ramosaeque. Sporae oblongae aut parce ovoideo-oblongae, decoloratae, 2–3-septatae, long. 0.010–0.012, crass. 0.003–0.004 mm. Gonidia globosa, diam. 0.006–0.010 mm., raro ellipsoidea et diam. $5 \times 3\mu$, simplicia aut glomerulosa, membrana modice incrassata. Facie externa apotheciorum subsimilis parvae *Lecanorae cateileae*. Supra folia *Mangiferae* prope flumen Punaruu (5142) et supra folia *Inocarpi edulis* ad flumen Papehue (eum *Sporopodio Inocarpi*, n. 5134 p.p.).

Crocynia Féei Vain. var. epiphaea Vain.

Lich. Ins. Philipp. III, p. 146.

Hypothecium purpureo-fuligineum. Discus isabellino-rufescens, margine pallescente cinctus. Ad corticem arboris in valle Maara (5370).

Graphis (Graphina) oblecta Nyl.

Ad corticem arboris in valle Fautaua (5448).

Graphis (Phaeographis) dendroides (Leight.) Vain.

Lich. Ins. Philipp, III, p. 221.

Ad corticem arboris in valle Punaruu (5385 A).

Graphis (Phaeographis) cohibens (Nyl.) Vain.

Lecanactis cohibens Nyl. Sert. Lich. Labuan, p. 24.

Ad corticem arboris in valle Fautaua (5450).

Graphis (Scolaeospora) rufula Mont.

Ad corticem arboris in palude Purau (5404).

Arthothelium fusconigrum (Nyl.) Vain.

Arthonia fusconigra Nyl. Lich. Exot., p. 245.

Ad corticem arboris in palude Purau (5407 A).

Endocarpon tahitense Vain. sp. nov.

Thallus squamoso-areolatus, squamis adnatis, vulgo contiguus, 1–0.5 mm. latis, difformibus, margine crenulatis aut haud profunde lacinulatis, planis, superne lurido-pallescentibus, opacis, subtus fuscescentibus, rhizinis brevibus, crebris, subpallidis. Apothecia thallo immersa, puncto fusco-nigricante in superficie thalli indicata. Perithecium fuscofuligineum, integrum. Paraphyses in gelatinam diffusae. Asci gelatinosi. Nucleus jodo dilutissime caerulescens, dein violascens. Sporae binae, decoloratae, murali-divisae, cellulis numerosis, in seriebus transversis 6–10, haud gelatinosae, long. 0.023–0.033, crass. 0.012–0.015 mm. Gonidia hymenialia globosa aut subglobosa, diam. 3–2 μ aut long. 5 et crass 3 μ (raro 6 $\times$ 3.5 μ). Gonidia thalli globosa aut ellipsoidea, diam. 0.006–0.010 mm., simplicia aut pleurococcoideo-divisa. In rupe ad Papenu (5361).

Bottaria (Anthracothecium) paramera (Nyl.) Vain.

Verrucaria Nyl. in Cromb. Lich. Chall. Exp., p. 227.

f. pallido-alba Vain.

Thallo albido-pallescente differens a specimine orig. (in herb. Nyl.), quod thallo intense pallido instructum est. Ad corticem arboris prope isthmum Taravao in ditone Hitiaa (5334).—Sporae 8-nae, fuscescentes, haud gelatinosae, primum 5-septatae, dein murali-divisae aut submurales, long. 0.028–0.041, crass. 0.010–0.017 mm.

Pyrenula oroferensis Vain. sp. nov.

Thallus tenuis, glaucescens, verruculis minutissimis, subalbidis inspersus. Apothecia crebra, verrucas formantia 0.5–0.7 mm. latas, basi haud constrictas, latere sat abrupto, strato thallino glauco, laevigato, obductas, vertice peritheciali 0.0025–0.003 mm. lato nigro, nudo, distincte limitato, nec prominente nec impresso. Perithecium subglobosum, integrum, fuligineum. Paraphyses simplices. Nucleus decoloratus. Sporae 8-nae, monostichae, fumoso-obscuratae, oblongae, apicibus obtusis, haud papillatis, 3-septatae, loculis apicalibus duplo minoribus, haud gelatinosae, long. 0.022–0.026, crass. 0.008–0.011 mm. Ad corticem arboris in valle Orofere (5306).

Porina (Segestria) Hibisci Vain. sp. nov.

Thallus sat tenuis, sat laevigatus aut leviter verruculoso-inaequalis, glauco-virescens, nitidus, continuus, linea hypothallina nigricante partim limitatus. Apothecia crebra, verrucas formantia 0.3–0.5 mm. latas, basim versus leviter dilatatas, hemisphaericas aut depresso-hemisphaericas, amphithecio thallino laevigato totas obductas, ostiolo punctiformi nigro pallidove. Perithecium pallidum. Nucleus albidus, jodo non reagens. Paraphyses simplices. Asci fusiformes. Sporae 8:nae, distichae decoloratae, fusiformes, 7-septatae, apicibus acutis, loculis cylindricis, fere aequae longis, haud gelatinosae, long. 0.030–0.036, crass. 0.005 mm. Ad ramos *Hibisci tiliacei* prope flumen Papehue (5131).—Proxima *P. innatae* (Nyl.) Zahlbr.

Porina (Sagedinula) Mangiferae Vain. sp. nov.

Thallus tenuissimus, subcontinuus, laevigatus, olivaceo-pallidus, opacus, hypothallo indistincto. Apothecia sat dispersa, verrucas formantia hemisphaericas, 0.3–0.25 mm. latas, fuscas vel fusco-nigras, leviter nitidas, ostiolo parum conspicuo. Perithecium nudum, lenticulari-hemisphaericum, rufescenti-fuligineum. integrum. Paraphyses simplices. Asci fusiformes. Sporae 8:nae, distichae, decoloratae, fusiformes, apicibus sat acutis aut sat obtusis, 5-septatae, loculis fere aequae longis, long. 0.022–0.028, crass. 0.004–0.006 mm., interdum tenuiter gelatinoso-indutae. Conidangia lat. 0.080 mm., conceptaculo depresso-subglobozo, rufescente, integro. Sterigmata simplicia, long. 0.010 mm., apicibus conidia efferentibus. Conidia bacilliformia, recta, long. 0.005, crass. 0.001 mm. Gonidia adnata, repentia, irregulariter ramosa, ramis irregulariter intricatis, nec lateribus connatis, cellulis anguloso-subglobozo aut parcius etiam oblongis difformibusve, 0.003–0.005 mm. latis, forsitan potius ad *Trentepohliam*, quam ad *Heterothallum* pertinentia. *Porinam Arengae* Vain. in memoriam revocans, at jam gonidiis ab ea differens. A *P. subtiliore* Vain. (Lich. Ins. Philipp. IV, p. 5) jam apotheciis majoribus differt. Supra folia *Mangiferae* in valle Fautaua (5091 p.p.).

Porina (Segestrinula) perminuta Vain. sp. nov.

Thallus tenuis vel tenuissimus, verruculis nullis, continuus aut subdispersus, sublividus vel olivaceo-cinerascens, opacus, hypothallo indistincto. Apothecia minutissima, lat. circ. 0.090 mm., crebra,

verruculas hemisphaericas aut depresso-subglobosas, basi non aut levissime constrictas, formantia. Perithecium subglobosum, fusconigrum, basi dilute coloratum vel sordide pallidum, amphithecio thallino, opaco obductum, in vertice angustissime aut rarius sat late denudato nigroque. Nucleus decoloratus, jodo dilutissime aut vix distincte subrubescens. Paraphyses simplices. Asci clavati aut subfusciiformes, membrana tenui. Sporae 8-nae, tristichae, decoloratae, oblongae aut fusiformi-oblongae, apicibus obtusis, rectae, 3-septatae, loculis cylindricis, fere aequae longis, long. 0.016–0.020, crass. 0.0035–0.005 mm., haud gelatinosae. Gonidia phycopeltidea, ramis irregularibus, lateribus partim connatis, cellulis difformibus. Supra folia *Mangiferae* prope Faaa (5085).—Apotheciis minoribus et magis prominentibus a *P. semecarpi* (Vain., Lich. Ins. Philipp. III, p. 367) et *P. subtiliore* (Vain., loc. cit. IV, p. 5) jam facie externa distinguitur.

***Strigula argentea* (Fée) Vain.**

Addit. Lich. Antill., p. 206.

Supra folia *Perseae gratissimae* in valle Fautaua (5096 p.p.).

REPORT UPON A COLLECTION OF FERNS
FROM TAHITI

BY
WILLIAM R. MAXON

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REPORT UPON A COLLECTION OF FERNS FROM TAHITI¹

BY

WILLIAM R. MAXON

During May, June, and July, 1922, W. A. Setchell and H. E. Parks, in the course of their study of the flora of Tahiti under the auspices of the Department of Marine Biology of the Carnegie Institution of Washington, made an extensive collection of the pteridophyta of the island, this material subsequently being turned over to the writer for study. So little has been written solely upon the ferns of Tahiti that it seems worth while to list the species of the present collection, especially since the 111 numbers collected represent no less than sixty-six species, three of these being new and several others unusually interesting because of their extreme rarity or of their peculiar morphology. In nearly all cases the collectors were at pains to note and set down full habitat data—a feature often altogether neglected—and these are copied almost literally, following the locality data for each specimen.

In preparing an annotated list of this collection the writer would have preferred to include also entries of all species that can be shown to occur in Tahiti. For several reasons this has not been practicable. The preparation of a complete list of the pteridophyta of almost any portion of Oceanica, recording precise rather than conventional identifications, would involve examining numerous historically important collections in European herbaria, and unraveling the complicated and often extensive synonymy of many collective species that have been reported widely from all Oceanica. The types, especially, are mostly to be sought abroad, and the work of revision ought preferably, therefore, to be undertaken by students to whom these are readily accessible. Until this is done it will be impossible to offer a dependable treatment of the pteridophyta of these regions, one which is based upon modern ideas of classification. Undoubtedly, some of the species are of the widest distribution; others are endemic to small areas, and need to be redescribed or illustrated; a third and most troublesome group consists of those species, already mentioned, that

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are assumed to be 'collective.' Of the last, some will be found to be genuinely polymorphic, within true specific limits; but a majority will probably prove susceptible of segregation into regional species of close interrelationship. With the proper material at hand for study the work offers no peculiar difficulties and it is essential that it be undertaken, since correct identifications in a strict sense are of basic importance in studies other than taxonomic.

The present collection contains some of the species described long ago by Brackenridge upon material collected in Tahiti by the U. S. Exploring Expedition under Captain Wilkes. Notes upon several of these are given in comparison with Brackenridge's types, which are in the U. S. National Herbarium. There are included, also, critical comments upon a few other species, either endemic or widespread, with references to the special literature. Unless otherwise indicated, the nomenclature is that of Christensen's Index Filicum.

OPHIOGLOSSACEAE

Ophioderma pendulum (L.) Presl

Habitat.—Maara Valley; high up on trees (427). Maara; hanging in large clusters from all kinds of trees (501).

MARATTIACEAE

Angiopteris evecta (Forst.) Hoffm.

Habitat.—Road to Papenu Valley; in small gulches, often forming a distinct trunk as much as 1.5 meters high (7).

SCHIZAEACEAE

Lophidium dichotomum (L.) Maxon

Maxon, in Proc. Biol. Soc. Washington, 1923 (vol. 36), p. 170.

Habitat.—Orofere Valley; among other ferns, in thick jungle at top of mountain (346).

Lygodium reticulatum Schkuhr

Habitat.—Near Papeari; climbing among low shrubs and herbs (234). About 1 km. east of Papenu bridge; climbing trees; abundant (270).

GLEICHENIACEAE

Dicranopteris linearis (Burm.) Underw.

Habitat.—Mt. Tahara; on rock cut (11).

CYATHEACEAE

Cyathea affinis (Forst.) Swartz

Habitat.—Fautaua Valley; trunks 3 to 5 meters high and about 10 cm. in diameter; fronds 1 to 1.5 meters long, sterile (215). Maara Valley; trunk 2 meters high; blades lanceolate, sterile (446).

POLYPODIACEAE

Tribe **Acrosticheae****Acrostichum aureum** L.

Habitat.—Tapahi; roadside (86). Road from Papenu to Huau; young plants at base of maritime cliffs (268).

Referred to this species only in its widest sense. A thorough revision of this group is urgently needed. The present plant bears no very close resemblance to that of tropical North America.

Tribe **Vittarieae****Antrophyum Lessonii** Bory

Habitat.—Fautaua Valley; on trees (248).

Antrophyum reticulatum (Forst.) Kaulf.

Habitat.—Road to Fort Faa Rahi; on shaded rocks (21). Maara Valley; on trees, in deep shade; fronds long, pendent (432). Papehue River; on *Hibiscus tiliaceus* (299).

Vittaria elongata Swartz

Habitat.—High up Fautaua Valley; covering a large rock with its very long, dark green, shining leaves (198). Fautaua Valley; crevices of rocks; fronds less shiny than 198, short, rigid (198a). Fautaua Valley; on rocks (243). Papehue River; high up on tree (301).

Habitally and in stature there is wide difference between the reduced, rigid plants of rock crevices (no. 198a) and the elongate,

lax, pendent plants numbered 301, the fronds more than a meter long. With such extraordinary variation exhibited in a single isolated region, it is easy to see how inevitably the name has come to be applied in a collective sense, in dealing with similar material widely spread through Asia and Polynesia.

Tribe **Polypodieae**

Hymenolepis spicata (L. f.) Presl

Habitat.—Fautaua Valley; occasional, on trees (195).

Cyclophorus blepharolepis C. Chr.

Habitat.—Road to Fort Faa Rahi; creeping over high branches of *Hibiscus tiliaceus* (25).

Endemic. Other specimens at hand are *Moore* 252, *Tilden* 348, and a plant of the Wilkes Expedition, the last originally labeled *Niphobolus bicolor* Kaulf. The alliance is unmistakably with *C. serpens* (Forst.) C. Chr.

Polypodium subnudum Mett.

Habitat.—Maara Valley; a half dozen clumps on under side of log spanning the river, about 3 meters above water (489). West branch of Fautaua Valley, altitude 600 meters; on under side of tree trunks; scarce (523).

Endemic. Previously collected by Vesco, Ribourt, and Nadeaud. An ally of *P. blechnoides* (Grev.) Hook.

Polypodium longissimum Blume

Habitat.—Road between Papeete and Papeari; common along moist banks; sweet-smelling when old and dry (235).

Polypodium euryphyllum C. Chr.

Habitat.—Maara Valley; on rocks, among mosses (445).

Polypodium scolopendrium Burm.

Habitat.—Road to Papenu; on rocks (2). Same locality (4).

As Merrill has recently shown (Philippine Jour. Sci., 1921 (vol. 19), p. 335), this is the proper name, published in 1768, for the plant usually known as *P. phymatodes* L., 1771.

***Polypodium punctatum* (L.) Swartz**

Habitat.—Papeari, between the 50 and 52-km. stones; on coconut tree, in "bush" (408).

It is evident that several species are confused under this name in herbaria. The present plant has the ligulate fronds pergamentaceous, translucent, 60 to 70 cm. long, 9 to 11 cm. broad, and quite exstipitate, the sessile base cordate, and only a little narrower than the middle of the frond.

***Polypodium maximum* (Brack.) Hook.**

Habitat.—Road to Papenu; on tree trunks (5). Lower end of Punaruu Valley; on high cliff, in shade (77).

A peculiar and very rare endemic species described and beautifully figured by Brackenridge as *Drynaria maxima*. Of the two numbers cited above, the first has fronds 110 to 120 cm. long, the blades 7 to 8 cm. broad, entire or coarsely crenate-undulate, and evenly long-attenuate downward, only the extreme base of the frond (4 to 6 cm.) being clear of a narrow foliaceous wing. A large specimen of the other (no. 77) is more like Brackenridge's type, and represents a more adult form; one of the fronds, though only 115 cm. long, has the blade 45 cm. broad and very deeply pinnatifid, much as in *P. scolopendrium*. (The maximum height, according to Brackenridge, is 1.5 meters.) In a second specimen of no. 77 a narrow entire frond and a broad deeply pinnatifid one are seen arising from the same rhizome.

Tribe Pterideae***Adiantum capillus-Veneris* L.**

Habitat.—Maara; walls of main caves (333).

***Adiantum hispidulum* Swartz**

Habitat.—Road to Fort Faa Rahi; on shaded rocks (22). Road over Mt. Tahara; on cliffs; frequent (115).

***Doryopteris concolor* (Langsd. & Fisch.) Kuhn**

Habitat.—Road to Fort Faa Rahi; on shaded vertical rocks (27). Lower end of Punaruu Valley; on dry rocks, in shade (73). Beyond Papenu bridge (279).

Hypolepis tenuifolia (Forst.) Bernh.

Habitat.—End of carriage road to Fort Faa Rahi; in bed of brook (18). Road from Papeete to Papeari; common on banks (236).

Notholaena hirsuta (Poir.) Desv.

Habitat.—Lower end of Punaruu Valley; on dry cliffs, in shade (75).

Pteris comans Forst.

Habitat.—Fautaua Valley; common at higher limits, but not fruiting very abundantly (204).

Pteris tripartita Swartz

Habitat.—End of carriage road to Fort Faa Rahi; in bed of brook (20).

The specimen is more luxuriant and has larger pinnules and segments than is usual for this species.

Tribe **Asplenieae****Asplenium gibberosum** (Forst.) Mett.

Habitat.—Fautaua Valley; in deep shade, under overhanging rocks; scarce (193). Orofere Valley; on trees, in dense shade (307).

A careful examination of these specimens suggests that the restoration of Moore's genus *Loxoscapha*, to accommodate this and a few closely related species, is well worth consideration. If not generically distinct they constitute a well-marked subgeneric group, at least, under *Asplenium*. The short broad indusia, being united to the leaf tissue laterally as well as basally, form deep pockets and are peculiarly davallioid in general appearance.

Asplenium laserpitiifolium Lam.

Habitat.—Maara Valley; on mossy rocks, in deep shade; lustrous (436).

Asplenium tenerum Forst.

Habitat.—West branch of Fautaua Valley; altitude 600 meters and above; on rocks; not abundant (520).

Asplenium nidus L.

Habitat.—Tapahi; roadside (83).

***Blechnum orientale* L.**

Habitat.—Road to Papenu, in small gulches; fronds in a crown (6).

***Diplazium polyanthos* (Sol.) C. Chr.**

Habitat.—Road to Fort Faa Rahi; in deep shade (17). Upper limits of Fautaua Valley; frequent (202).

Endemic.

***Stenochlaena Setchellii* Maxon, sp. nov.**

Plate 1

Rhizome high-climbing, strongly compressed, 1 cm. broad, light brown, nearly naked with age, the apical portion (10 cm.) densely paleaceous, the scales laxly imbricate, linear-attenuate, 6 to 8 mm. long, thin, light brown, laxly fibrillose-ciliate. Sterile frond 85 cm. long; stipe 20 cm. long, light brownish to olivaceous, trisulcate anteriorly, chaffy at the arcuate base; blade narrowly oblong, abruptly acute, 65 cm. long, about 22 cm. broad at the middle, 25 cm. at the truncate base, simply pinnate, with a conform terminal pinna; rachis dull olivaceous, non-alate; pinnae 16 pairs, mostly inserted 3 to 5 cm. apart on either side, nearly straight, linear-oblong, 12 to 15 cm. long, 2 to 2.5 cm. broad, acuminate at the unequal base, long-acuminate in the apical third (the tip attenuate and sharp-pointed), the lower ones spreading and distinctly petiolate (5 mm.), the others oblique and shorter-petiolate, the stalks faintly alate; midribs narrow, stramineous, elevated; leaf tissue membranous-herbaceous, the margins entire, slightly thickened, subrevolute or plane; veins wide-spreading, mostly simple, about 1 mm. apart. Fertile frond (incomplete) about 70 cm. long; stipe 17 cm. long, light brownish; blade 53 cm. long, the rachis very slender; pinnae about 15 pairs, distant, alternate, stalked, oblique, narrowly linear, 15 to 20 cm. long, 0.7 to 1.2 mm. broad, lax, drooping, plane.

Type.—U. S. National Herbarium, no. 1,094,873, collected on a tree trunk in the Maara Valley, Tahiti, June 22, 1922, by W. A. Setchell and H. E. Parks (no. 418).

Stenochlaena Brackenridgei (Carr.) Underw., of Fiji, which is the nearest relative of this extremely well-marked new species, differs notably in having the pinnae of the sterile fronds only half as numerous (7 or 8 pairs), conspicuously and heavily long-stalked (nearly 1 cm.), linear-elliptic and long-tapering at both ends, dis-

tinctly coriaceous in texture, and callous-marginate. There is a strong similarity only in the drooping grasslike appearance of the extremely narrow pinnae of the fertile fronds.

Tribe Dryopterideae

Dryopteris Brackenridge (Mett.) Kuntze

Plate 2

Habitat.—Arched cliff-front of Maara Cave; on dripping rocks (173). Upper limits of Fautaua Valley; frequent (216). Maara Valley; mossy banks, in deep shade (447).

Ascribed to Polynesia in general. The type is a Tahiti specimen described and figured by Brackenridge as *Lastrea attenuata* Brack., an invalid name. With this the present specimens accord perfectly. It is apparently a rare species.

Dryopteris leucolepis (Presl) Maxon

Habitat.—End of carriage road to Fort Faa Rahi; in bed of brook (19). Road from Papeete to Papeari; “rachis and stipe scaly and bristly” (237).

An ally of *D. setigera*, recently discussed at length by the writer (Proc. Biol. Soc. Washington, 1923 (vol. 36), pp. 170–173). It was described originally from the Philippines and reaches its extreme eastern limit in Tahiti. Its long-ciliate dirty white scales and muricate rachises readily distinguish it from *D. setigera*.

Dryopteris setigera (Blume) Kuntze

Habitat.—Roadside, about 1 km. east of Papenu bridge (277).

A widely distributed East Indian, Polynesian, and Asiatic species, whose characters have been discussed by the writer in connection with *D. leucolepis* and *D. ornata* (Wall.) C. Chr. The rachises are smooth and shining throughout, in distinction to the other two species, and the basal tuft of lustrous, dark brown, short-ciliate scales is equally diagnostic. Both this species and *D. leucolepis* are indusiate, also, while *D. ornata* is not.

Dryopteris sciaphila Maxon, sp. nov.

Rhizome stout, decumbent, 2 to 3 cm. thick or more, about 10 cm. long, everywhere copiously paleaceous, the scales erect, densely tufted, bright brown, linear-filiform, 1.5 to 2 cm. long, subflexuous, entire.

Fronds several, recurved-ascending, the largest one 95 cm. long; stipe 45 cm. long, 2 to 3 mm. thick, light brown to dull stramineous from a dull castaneous arcuate base, angulate, deciduously paleaceous, the scales ascending or mostly appressed; blade broadly deltoid-ovate, acuminate, 50 cm. long, nearly 50 cm. broad, tripinnate or nearly quadripinnate; structure strongly catadromous, except as to the major divisions of the pasal pinnae; major pinnae about 8 pairs, the basal ones the largest, 30 cm. long, 25 cm. broad at base, deltoid, inequilateral, basiscopic, long-stalked (3 to 4 cm.); second pair of pinnae inserted 14 cm. above, shorter, narrower, and nearly equilateral, those above successively narrower, oblong, somewhat acroscopic; secondary pinnae adjacent to distant, sessile to long-stalked (10 mm.), triangular-oblong, long-acuminate, spreading; pinnules 10 pairs or more, spreading, the larger ones sessile and nearly pinnate (the divisions serrate-dentate), the others semiadnate, or adnate and decurrent, deeply and obliquely incised, the lobes about 5 or 6 pairs; pinnules in general narrowly triangular-oblong, 8 to 15 mm. long, acute or acuminate, approximate, membranous, translucent, distantly ciliolate; rachises slender, angulate, crispate-puberulous above (the short griseous septate hairs extending to the midveins and veins), beneath whitish-strigillose and sparsely paleaceous, the scales bright brown, linear to lance-attenuate, mostly appressed; veins free, evident, whitish-strigillose beneath; sori rather small, distant, nearly medial; indusia thin, roundish-reniform, soon shriveling, fringed with turgid white allantoid unicellular hairs, similar to those of the veins beneath.

Type.—U. S. National Herbarium, nos. 1,094,878 and 1,094,879, comprising a single complete frond, collected on deeply shaded mossy banks, Maara Valley, Tahiti, June 22, 1922, by W. A. Setchell and H. E. Parks (no. 444). A smaller specimen, with rhizome attached, is *Setchell & Parks* 414, collected from a roadside cut, between the 50 and 52-km. stones, Papeari, Tahiti, June 21, 1922; this is only sparingly fertile, and obviously represents an immature state.

Dryopteris sciaphila is a member of the group of East Indian and tropical Asiatic species centering around *D. sarawakensis* (Baker) Copeland, discussed several years ago (*Philippine Jour. Sci. C. Bot.*, 1907 (vol. 2), pp. 215–217) by Christ, who described several new species and varieties from the Philippine Islands. It most resembles very large states of *D. sarawakensis* itself, but that species differs widely in its elongate and much simpler blades and its broader, sub-bullate, spreading or reflexed rachis scales.

***Dryopteris costata* (Brack.) Maxon**

Goniopteris costata Brack. in Wilkes, U. S. Expl. Exped., 1854 (vol. 16), p. 28. Not *Goniopteris costata* J. Sm. (*nomen nudum*), 1841, which is *Dryopteris penangiana* (Hook.) C. Chr.

Polypodium costatum Hook., Sp. Fil., 1863 (vol. 5), p. 7. Not *Polypodium costatum* Kunze, 1834, nor Mett., 1857.

Nephrodium costatum Diels in Engl. and Prantl, Pflanzenfam., 1899 (vol. 1, pt. 4), p. 179. Not *Nephrodium costatum* Bedd., 1867, which is *Dryopteris penangiana*.

Habitat.—Banks of Punaruu River; leaves rigid, in a crown (359).

The present specimen, which consists of a complete frond (90 cm. long) attached to a vertical half-section of the large erect rhizome, closely matches the type specimen of *Goniopteris costata* Brack., from Tahiti. *Goniopteris costata* Brack. is listed by Christensen as a subspecies of *Dryopteris pennigera* (Forst.) C. Chr., but it was taken up as distinct from that New Zealand species by Hooker and by Diels, as above indicated, and this course seems entirely justified. The more obvious points of distinction from *D. pennigera* are the evenly attenuate bases of the blades (several lower pairs of pinnae being greatly reduced, the lowermost ones vestigial, less than 1 cm. long), the oblique, less deeply incised pinnae, the more oblique, acute or acutish segments, and the thick, rigidly herbaceous texture.

There is some doubt as to whether *D. costata* actually occurs in Fiji also. Brackenridge ascribes it to both Fiji and Tahiti, and the type specimen is so marked. But the locality slip accompanying the plant reads "Tahiti" only, and since identical material now turns up from Tahiti this may safely be regarded as the type locality. Not improbably the species will be found also in Fiji. Diels mentions it from Fiji, possibly on the authority of Brackenridge.

***Dryopteris longissima* (Brack.) C. Chr.**

Habitat.—Fautaua Valley, near the Fort; only a single clump observed; stipe and rachis bristly (194).

Endemic and apparently a very rare plant in Tahiti; first described as *Goniopteris longissima* Brack. According to Brackenridge the trunk is "stout, 2 to 3 feet in height, and crowned with large, spreading pinnate fronds, 3 to 4 feet broad." He adds, "One of the most majestic plants of the tribe Polypodieae; and only once detected by us, on the high mountains of Tahiti, while on a hurried visit to Lake Waihera." The rachis is described as "beset with scattered

paleaceous subulate hairs, of half an inch to an inch in length." The truly ligulate pinnae are deeply pinnatifid, the segments being narrowly linear-oblong.

Notwithstanding these remarkable characters, this species was merely mentioned in the Synopsis Filicum under *Polypodium costatum* Hook. (*Dryopteris costata* of the present paper) as "probably a larger form of the same plant; but . . . the rachis is muricate." Diels, however, has properly recognized the plant as distinct, under the name *Nephrodium longissimum*. The synonymy is as stated in Christensen's Index Filicum.

The present specimen accords closely in every respect with the type, the original description, and the beautiful folio illustration. Strangely enough Brackenridge fails even to mention the muricate character of the rachises, referred to by Baker, though this feature is conspicuous along the ventral face of the rachis in the type specimen. The prominences are sometimes sharp and nearly 1 mm. long; they are, of course, the seat of the curious long, rigid, spreading, subulate scales. The stout yellowish brown stipe is densely muricate and subulate-paleaceous on all sides. Not only are the prominent close veins densely puberulous-setose below, but the leaf surfaces as well; the segments are glabrous and lustrous above, with impressed veins. No trace of an indusium is discernible. The sporangia are non-setose.

***Dryopteris gongylodes* (Schkuhr) Kuntze**

Habitat.—Ahonu Valley; abundant in meadows (98).

***Dryopteris invisā* (Forst.) Kuntze**

Habitat.—Road to Papenu; at base of steep cliff (9). End of carriage road to Fort Faa Rahi; in bed of brook (16).

The setose indusia at once distinguish this from related species of similar gross morphology.

***Dryopteris parasitica* (L.) Kuntze**

Habitat.—Punaruu River; in shaded forest (357, 358).

***Leptochilus cuspidatus* (Presl) C. Chr.**

Habitat.—Papehue River; in and around rocks and bases of trees (295). Maara Valley (435).

Lomagramma Wilkesiana (Brack.) Copeland

Plates 3, 4

Copeland, in Philippine Jour. Sci. C. Bot., 1908 (vol. 3), p. 32.

Polybotrya Wilkesiana Brack. in Wilkes, U. S. Expl. Exped. 1854 (vol. 16), p. 80, pl. 10.*Acrostichum Wilkesianum* Hook., Sp. Fil., 1864 (vol. 5), p. 247.*Acrostichum mutabile* Naud. Enum. Pl. Tahiti, 1873, p. 28.

Habitat.—Fautaua Valley; bipinnate form (211). Papehue River; climbing over trees and rocks in great masses, ascending to tops of trees; sterile; bipinnate form (294). Papehue River; climbing to tops of trees, associated with no. 294; sterile; once-pinnate form (296). West branch of Fautaua Valley, at 600 meters altitude; climbing high trees; fertile; once-pinnate form (512). Orofere Valley; once-pinnate, bipinnate, and intermediate forms (315).

Polybotrya Wilkesiana, as described and figured by Brackenridge upon Tahiti material, is a climbing plant with naked rhizomes and both sterile and fertile fronds completely bipinnate, the primary and secondary segments articulate. The plant is no *Polybotrya*, but a free-veined species of *Lomagramma*, closely allied to *Lomagramma articulata* (J. Sm.) Copeland, of the Philippines.

The bipinnate character of *L. Wilkesiana* is, however, not constant. Thus, Nadeaud, writing on the plants of Tahiti in 1873 (Enum. Pl. Tahiti, p. 28), reports having collected abundant specimens ranging from pinnate to bipinnate, growing from the same rhizome. To this aggregate he applied the new name *Acrostichum mutabile*: the simply pinnate form he erroneously supposed to represent the New World *Acrostichum sorbifolium* L. (*Stenochlaena sorbifolia*); the bipinnate condition he called var. *Wilkesiana*, applying this name correctly. This curious polymorphism of the Tahiti plants is also stated briefly by Drake del Castillo (Fl. Polynes. Franc., 1892, pp. 319, 320) in redescribing them as *Acrostichum Wilkesianum* Hook. In addition, Christ (Bot. Jahrb. Engler, 1897 (vol. 23), p. 361) has reported under this name a Samoan plant (*Reinecke 87b*) as exhibiting the same diversity. There is at hand a simply pinnate frond of *Reinecke 87b*; but from this alone it is not possible to say whether the Samoan form is identical with that of Tahiti. Christ mentions also a New Caledonia plant that he considers identical; but all the New Caledonia specimens available to the writer are bipinnate and in the character of their dissection indicate a species distinct from *L. Wilkesiana* of Tahiti. This will be described elsewhere.

Only one blade intermediate in dissection between the simple and bipinnate forms assumed by the sterile fronds is at hand in the present material from Tahiti, this being no. 315 in part; the other numbers are either wholly bipinnate or once-pinnate. The only fertile fronds of this collection are simply pinnate, though the Brackenridge type shows both fertile and sterile bipinnate fronds. It is probable that fertile fronds of intermediate form also occur.

***Polystichum aristatum* (Forst.) Presl**

Habitat.—West branch of Fautaua Valley, at 600 meters altitude; on trees and among rocks (519).

***Tectaria decurrens* (Presl) Copeland**

Habitat.—Maara Valley; on mossy banks and cliffs, in deep shade (442).

***Tectaria tahitensis* Maxon, sp. nov.**

Plates 5, 6

Fronds several, erect-spreading, the largest one 165 cm. long; rhizome woody, decumbent, stout, elongate, densely paleaceous at the tip, the scales tufted, 1 cm. long or more, linear-attenuate, hair-pointed, bright to dark brown, rigid, lustrous, somewhat twisted, bearing numerous filiform, mainly retrorse, fibril-like teeth; stipe 90 cm. long, stout, flattish and deeply sulcate in drying (4 to 9 mm. thick), lustrous, dark purplish-castaneous at base, bright brown above, naked; blade triangular-ovate, short-acute, 75 cm. long, about 60 cm. broad at base, fully bipinnate as to the basal portion of the two lowest pairs of pinnae, otherwise pinnate-pinnatifid; main pinnae 5 pairs, spreading, the basal pair much the largest, 35 cm. long, 25 cm. broad, obliquely deltoid, abruptly acute, inequilateral, strongly basiscopic, long-petiolate (7 cm.), the basal pair of pinnules petiolate (5 to 15 mm.), deltoid-ovate, acuminate, obliquely pinnatifid throughout (the larger lobes crenate or crenately lobed), the second pair of pinnules sessile or nearly so, oblong, acuminate, acutely pinnatifid, the next three or four pairs of pinnules much smaller, decurrent and broadly joined, oblique, narrowly oblong to triangular-lanceolate, obliquely lobed or coarsely crenate, the apical ones close, small, abruptly reduced; second pair of pinnae 19 cm. distant, opposite, long-petiolate (3.5 cm.), obliquely deltoid, inequilateral, basiscopic, similar to the basal pinnae but only the lowermost

pair of pinnules free, these short-stalked; third pair of pinnae distant 12 cm., subopposite, stalked (2 cm.), obliquely deltoid-ovate, the basal pinnules subsessile, obliquely cleft, the others decurrent and broadly joined, obliquely and coarsely crenate; fourth pair of pinnules 10 cm. distant, stalked (about 1 cm.), triangular-oblong, coarsely and obliquely pinnatifid, the lobes crenate, long-acuminate; remaining pinnae (two or three pairs) adnate, broadly joined, narrowly oblong, the apex itself with several small alternate lobes; rachises bright brown, lustrous, the midveins similar or paler, strongly elevated, glabrous; ultimate veins prominulous, the areoles irregularly polygonal, variable in size, mostly with recurved included veinlets; sori rather numerous, borne sparsely on the wings and in single rows on either side of the strongly flexuous midveins of the pinnules and major lobes, the receptacles small, punctiform; indusia and paraphyses wanting. Leaf tissue thin-membranaceous, dull green, glabrous except for the distinctly callous subrevolute margins, these glandular-ciliolate.

Type.—U. S. National Herbarium, nos. 1,094,861–3, comprising a single nearly complete frond without rhizome, collected in moist shade along the Papehue River, Tahiti, among rocks, June 7, 1922, by W. A. Setchell and H. E. Parks (no. 298). The data as to rhizome are drawn from two smaller specimens, no. 557 of the same collection, these said to be “probably from Fautaua Valley,” Tahiti. There is at hand also a Tahiti specimen of the Wilkes Exploring Expedition, identified long ago as *Drynaria latifolia* Brack. (Brack. in Wilkes, U. S. Expl. Exped., 1854 (vol. 16), p. 50).

Tectaria tahitensis is a member of the subgenus *Arcypteris*, and finds its nearest ally in *T. Setchellii* Maxon (Proc. Biol. Soc. Washington, 1923 (vol. 36), p. 174) of Samoa. That species differs notably, however, in its dull (not polished), cinnamon-brownish stipes and rachises and its smaller, very much simpler blades, the pinnae not strongly basiscopis. Both are nonindusiate and nonparaphysate. Notes on several species of this alliance and their involved taxonomy are given following the description of *T. Setchellii*.

Tribe Davallieae

Arthropteris oblitterata (R. Br.) J. Sm.

Habitat.—Maara Valley; on mossy rocks (428).

Davallia elata (Forst.) Spreng.

Habitat.—On face of the Diadem; altitude 750 meters and above (532).

Davallia solida (Forst.) Swartz

Habitat.—Road over Mt. Tahara; on slopes (124). Beyond the Maara caves, at about the 34-km. stone; climbing trees, in swamp of *Hibiscus tiliaceus* (184).

No. 184 is a large specimen of the plant described as *Davallia tahitensis* Brack. It is remarkable for its truly linear sori and persistent scurfiness beneath, but is apparently no more than a form of *D. solida*, as that species is currently understood. The plants commonly so referred show extraordinary variation, not only regionally but habitally and with respect to age and degree of fertility.

Humata pectinata (J. E. Smith) Desv.

Habitat.—Maara Valley; on tree trunks, the slender rhizomes creeping widely among mosses (441). West branch of Fautaua Valley, altitude 600 meters; on trees (518). On face of the Diadem, altitude 750 meters; climbing over tree trunks (530).

Nephrolepis biserrata (Swartz) Schott

Habitat.—Maara caves; pendent on dry cliffs (174).

Nephrolepis hirsutula (Forst.) Presl

Habitat.—Lower end of Punaruu Valley; along shaded path; abundant (76).

Sphenomeris chinensis (L.) Maxon

Habitat.—About 1 km. east of Papenu bridge; on moist banks (271).

This is the common Old World insular and Chinese plant long known as *Davallia tenuifolia* Swartz and more recently as *Odontosoria chinensis* (L.) J. Sm. It is related closely to another Old World species first described as *Davallia retusa* Cav. and a plant of Florida and the West Indies described as *Adiantum clavatum* L., the three together forming the genus *Sphenomeris* described by the writer in 1913 (Jour. Washington Acad. Sci., vol. 3, p. 144). The grounds for

separating this group of small plants of determinate upright growth from *Odontosoria*, a genus of ten tropical American species characterized by scandent vinelike habit and indeterminate growth, have subsequently been stated in detail (Contr. U. S. Nat. Herb., 1913 (vol. 17), pp. 157–168).

HYMENOPHYLLACEAE

Trichomanes omphalodes (Vieill.) C. Chr.

Habitat.—Papehue River; on dripping rocks (5346).

Trichomanes bipunctatum Poir.

Habitat.—Road to Fort Faa Rahi; on very wet, shaded rocks (28). Fautaua Valley; on shaded rocks (205, 220). Papehue River; on trees (290). Orofere Valley; on trees, in deep shade (305). West branch of Fautaua Valley, altitude 600 meters; on trees (514).

Trichomanes caudatum Brack.

Habitat.—On face of the Diadem, altitude 750 meters; with *Tmesipteris tannensis*, on tree trunk (538).

Trichomanes humile Forst.

Habitat.—Fautaua Valley; on shaded rocks; apparently frequent (214). Small valley at Maara; on mossy rocks, in deep shade (488).

LYCOPODIACEAE

Lycopodium cernuum L.

Habitat.—Between Papenu and Huau; on roadside bank (278). Papeari District; on dry banks along phaeton road (471).

Lycopodium phlegmaria L.

Habitat.—Maara Valley; on trees, in deep shade (434).

PSILOTACEAE

Psilotum complanatum Swartz

Habitat.—Cultivated plant, originally from Tautira (316). Low down in Maara Valley; pendent in clusters of *Ophioderma pendulum* (500).

Psilotum nudum (L.) Griseb.

Habitat.—Fautaua Valley; in crevices of rocks (190). Upper limits of journey up Papehue River; high up on tree (302). Punaruu River; on shaded rocks (356).

Tmesipteris tannensis Bernh.

Habitat.—On face of the Diadem, altitude 750 meters; on trunks of trees; scattering (537).

SELAGINELLACEAE¹**Selaginella laxa** Spring

Habitat.—Fautaua Valley; on shaded rocks; scarce (197).

Selaginella vitiensis Baker

Habitat.—Fautaua Valley; on shaded rocks; scanty (257).

Selaginella Setchellii O. C. Schmidt, sp. nov.

Habitat.—Fautaua Valley; on shaded rocks; not very abundant (258).

Selaginella Zelinckii Hieron

Habitat.—Maara Valley; base of dripping mossy cliff, in deep shade (429).

Selaginella samoensis Baker

Habitat.—Face of the Diadem, altitude 600 meters; widely scattered on very wet rocks (533).

Selaginella sp.

Habitat.—Fautaua Valley; sterile (214a).

¹ Identified by Dr. O. C. Schmidt, of the Berlin Botanical Museum.

EXPLANATION OF PLATES

PLATE 1

Stenochlaena Setchellii Maxon, sp. nov. Approximately $\times .45$.



190873

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PLATE 2

Dryopteris Brackenridgei (Mett.) Kuntze. Approximately $\times .45$.

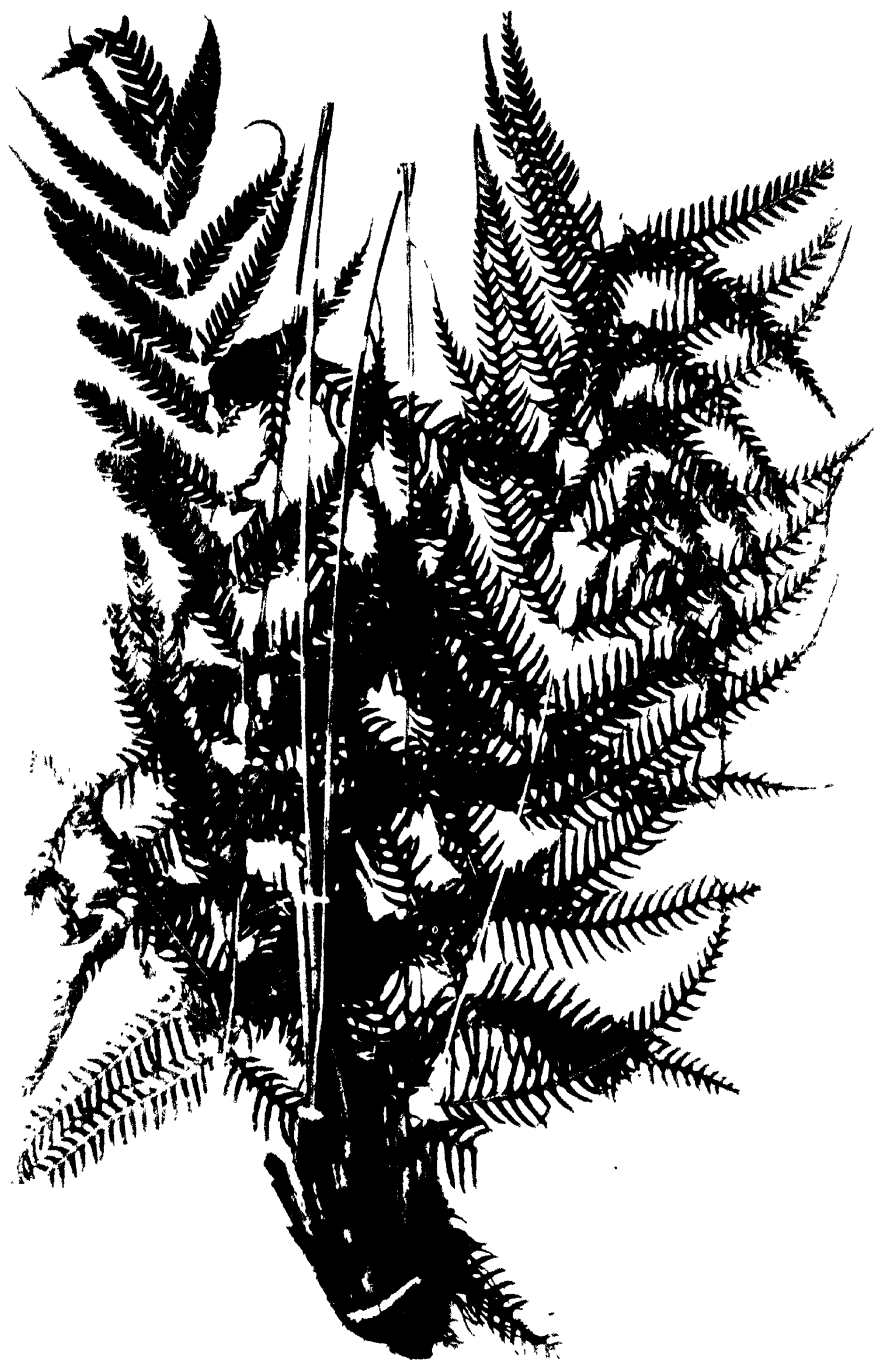


PLATE 3

Lomagramma Wilkesiana (Brack.) Copeland. Approximately $\times .45$.
The simply pinnate form.



PLATE 4

Lomagramma Wilkesiana (Brack.) Copeland. Approximately $\times .45$.

Once pinnate, bipinnate, and intermediate sterile fronds.



UNITED STATES NATIONAL MUSEUM

Plants of Tinian, Borje's Island

PLATE 5

Tectaria tahitensis Maxon, sp. nov. Approximately $\times .45$.

Basal part of type specimen.



PLATE 6

Tectaria tahitensis Maxon, sp. nov. Approximately $\times .45$.
Upper portion of type specimen.



TAHITIAN MOSSES
COLLECTED BY W. A. SETCHELL AND H. E. PARKS

DETERMINED BY
V. F. BROTHERUS

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TAHITIAN MOSSES

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DICRANACEAE

Holomitrium vaginatum Brid.

Nos. 5312, 5314. Maara Valley, District of Papeari, June 29, 1922.

Thysanomitrium Blumii (Doz. et Mol.)

No. 5428. Fautaua Valley, District of Pare, May 31, 1922.

LEUCOBRYACEAE

Leucophanes glaucescens C. Müll.

No. 5325. Along shore road in District of Hitiaa, June 24, 1922.

CALYMPERACEAE

Syrrhopodon Banksii C. Müll.

Nos. 5310, 5310B. Maara Valley, Papeari District, June 29, 1922.

Nos. 5324, 5325 p.p. Along shore road in District of Hitiaa, June 24, 1922.

f. **gracilis**

No. 5366. Maara Valley, District of Papeari, June 22, 1922.

Syrrhopodon constrictus Sull.

No. 5204. Maara Valley, District of Papeari, June 22, 1922.

Syrrhopodon glaucus Besch.

No. 5326. Maara Valley, District of Papeari, June 29, 1922.

***Calymperes Aongstroemii* Besch.**

No. 5391. Purau Swamp, at about the 34 km. stone, beyond the Maraa Caves, District of Paea, May 29, 1922.

ORTHOTRICHACEAE

***Macromitrium subtile* Schwaegr.**

No. 5301. Orofere Valley, District of Paea, June 8, 1922.

No. 5353. Roadside beyond Papenu River, District of Papenu, June 5, 1922.

No. 5374. Punaruu Valley, District of Punaauia, June 15, 1922.

Nos. 5390, 5392. Purau Swamp, at about the 34 km. stone, beyond the Maraa Caves, District of Paea, May 29, 1922.

BRYACEAE

***Bryum leptothecium* Taylor**

Nos. 5423, 5429. Fautaua Valley, District of Pare, May 31, 1922.

BARTRAMIACEAE

***Philonotis Jardini* Besch.**

No. 5339. Fautaua Valley, District of Pare, June 3, 1922.

METEORACEAE

***Papillaria helictophylla* (Mont.) Broth.**

No. 5355. Roadside beyond Papenu River, District of Papenu, June 5, 1922.

No. 5389. Purau Swamp, at about the 34 km. stone, beyond the Maraa Caves, District of Paea, May 29, 1922.

Nos. 5427, 5430. Fautaua Valley, District of Paea, May 31, 1922.

***Papillaria Aongstroemii* C. Müll.**

No. 5302. Orofere Valley, District of Paea, June 8, 1922 (p.p.).

No. 5315. Maara Valley, District of Papeari, June 29, 1922.

PHYLLOGONIACEAE

Orthorhynchium cylindricum (Lindb.) Broth.

No. 5084. Fautaua Valley, District of Pare, May 31, 1922.

NECKERACEAE

Calyptothecium praelongum Mitt.

No. 5313. Maara Valley, District of Paea, June 29, 1922.

No. 5424. Fautaua Valley, District of Pare, May 31, 1922.

Neckeropsis Lepineana (Mont.) Fleisch.

No. 5135. On trees, Papehue River, District of Paea, June 7, 1922.

ENTODONTACEAE

Entodon turgidus (Aongstr.) Jaeg.

No. 5316. Maara Valley, District of Papeari, June 29, 1922.

HOOKERIACEAE

Callicostella oblongifolia Sull.

No. 5365. Maara Valley, District of Papeari, June 22, 1922.

HYOPTERYGIACEAE

Hypopterygium Nadeaudianum Besch.

No. 5362. Maara Valley, District of Papeari, June 22, 1922.

HYPNACEAE

Ectropothecium sodale (Sull.) Mitt.

Nos. 5300, 5302. Orofere Valley, District of Paea, June 8, 1922.

No. 5364. Maara Valley, District of Papeari, June 22, 1922.

Nos. 5425, 5426. Fautaua Valley, District of Pare, May 31, 1922.

Vesicularia bryifolia (C. Müll.) Broth.

Nos. 5338, 5340. Fautaua Valley, District of Pare, June 3, 1922.

No. 5363. Maara Valley, District of Papeari, June 22, 1922.

Vesicularia inflectens (Brid.) C. Müll.

Nos. 5069, 5073B. On dripping rocks, Maraa Caves, District of Paea, May 29, 1922.

No. 5413. Maara Valley, District of Papeari, June 29, 1922.

Taxithelium Vernieri (Dub.) Besch.

No. 5347. Papehue River, District of Paea, June 7, 1922.

TAHITIAN FUNGI
COLLECTED BY W. A. SETCHELL AND H. E. PARKS

BY
HAROLD E. PARKS

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TAHITIAN FUNGI

COLLECTED BY W. A. SETCHELL AND H. E. PARKS

BY
HAROLD E. PARKS

During our stay in Tahiti, which extended from May 16 to July 19, 1922, we made as thorough a search for fungi as other duties permitted. A considerable number were collected, field notes taken, and preparations made so far as our facilities allowed. We are indebted to various specialists for notes as to the identity of our specimens, especially to Messrs. C. G. Lloyd, of Cincinnati, and J. R. Weir, in charge of the Pathological Collections of the Bureau of Plant Industry of the U. S. Department of Agriculture, of Washington, D. C., and through the latter to his colleagues, W. W. Diehl and Miss V. K. Charles. The partial report now presented represents fifty-one species tentatively determined and is placed on record as an addition to the scanty knowledge of the fungi of one of the islands of eastern Polynesia, of whose fungus flora, so far as I am aware, little is known. The various exploring expeditions into the Pacific have of necessity paid little attention to fungi and have placed very few on record. I have added my field notes in the form in which they were taken, together with my own comments or those of my correspondents.

The specimens are deposited in the Herbarium of the University of California, with duplicates in the Lloyd Herbarium at Cincinnati, and in the "Pathological Collection" of the Bureau of Plant Industry of the U. S. Department of Agriculture at Washington.

XYLARIACEAE

Xylaria caespitulos (Cooke) Rehm.

Scant, small black stalks, 1-3 cm. high, caespitose, 3-4 in a cluster, on rotting wood, uncommon. Determined by C. G. Lloyd. No. 8000. Papenu, May 20.

Xylaria cubensis Mont.

Club-shaped, 8-10 mm. broad. 2-4 cm. high, single, erect, and scattering over wet woody surfaces, stroma black with long sterile stipe-like base, uncommon. No. 8023. Papara, in swamp on Hibiscus, May 28. Determined by C. G. Lloyd. No. 8070. Tautira, June 21.

***Xylaria rhopaloides* Mont.**

Single, scattering over woody surfaces, stroma very long, black, 3–6 cm. high, 3 mm. thick, rare, on rotting wood. Determined by C. G. Lloyd. No. 8049. On Hibiscus, Papehue Valley, June 7.

***Hypoxylon haematostroma* Mont.**

Surface red, in young specimens bright, duller in old, pulverulent, 2–4 mm. thick, effused over large areas on all kinds of dead wood, common. Determined by C. G. Lloyd. No. 8009. Fautaua Valley, on dry, hard, dead Hibiscus, May 31. No. 8038. Paea, on coconut and Hibiscus, June 13.

***Hypoxylon tahitensis* Baccarini**

Fruiting bodies large, cushion shaped, 2–4 cm. broad, 5 mm. thick, surface smooth and even, purple black in color, not common or conspicuous but easily mistaken for *H. haematostroma* if old. No. 8071. Papeari, June 30, on Hibiscus. Determined by C. G. Lloyd. Diehl is inclined to refer this number to *H. ovinum* Berk.

***Hypoxylon vinosum* Berk.**

Dark red, thin, surface even, smooth, effused over small areas of dry decaying wood, appearing much like the other reddish species (*H. haematostroma* Mont.) so frequently found. Determined by C. G. Lloyd. No. 8035. Paea, June 13, on Hibiscus.

***Daldinia concentrica* (Bolt.) Ces. and De Not.**

Fruiting bodies typical, large, purple-black, smooth, context carbonaceous, 3–6 cm. in size, cushion-shaped to globose, occasional, probably common. Determined by C. G. Lloyd. No. 8002. Papenu, on rotting *Carica Papaya*, May 20. No. 8019. Paea, May 27, on rotting *Carica Papaya*.

***Kretzschmaria Clavus* Fr.**

Very small, inconspicuous forms, black, among mosses on bark of trees and on decaying wood, like small club-shaped *Xylarias*, 5–10 mm. high. Determined by J. R. Weir and W. W. Diehl. No. 8090. On Hibiscus wood, Papeari, June 22.

Hypoxylina sp.

Fruiting bodies abundant, round, black, beadlike, 5–10 mm. high, on under side of dry dead log, sometimes sessile, but many with a very short but distinct stipe, black and rough, inconspicuous. Determined by C. G. Lloyd. No. 8047, on dead, dry Citrus log, Paea, June 7.

SPHAERIACEAE

Rosellinia Langloisii E. and E.

Perithecia small, black, carbonaceous, 1–2 mm., single or in groups over drying rotten wood, not abundant. Determined by W. W. Diehl. No. 8039A. Papeari, June 30.

Rosellinia subiculata (Schw.) Sacc.

Perithecia 1–2 cm., black, inconspicuous on small limbs and dead twigs, not common. Determined by W. W. Diehl. No. 8031. On Hibiscus, Paea, June 7.

Eutypa flavovirens (Hoffm.) Tul.

Small black perithecia on bark and twigs of dead dry *Hibiscus tiliaceus*. Determined by W. W. Diehl. No. 8039. Papeari, June 20

HYPOCREACEAE

Hypocrea rufa (Pers.) Fr.

Small brownish to black perithecia found occasionally with old Hypoxylon. Determined by W. W. Diehl. No. 8032. On *Hypoxylon* sp., Paea, June 7.

PUCCINIACEAE

Uromyces Vignae Barcl.

Sori very small and light colored, on the under side of leaves of leguminous plants, along the strand. Determined by W. W. Diehl. No. 8095. Taapuna, June.

AURICULARIACEAE

Auricularia mesenterica Fr.

Large, sessile or resupinate form, grayish to flesh colored, hymenium nearly smooth, without many convolutions. No. 8050. On very wet wood, Fautaua Valley, June. Determined by C. G. Lloyd. No. 8060. On very wet wood, Punaruu Valley, June.

Auricularia auricula L.

Dark colored, small and much folded fruiting bodies, on wet wood. Determined by C. G. Lloyd. No. 8029. Papehue Valley, June 7.

Auricularia polytricha Mont.

Plants large, conspicuous, gray to flesh colored or darker, much folded, very common on rotting wood. Determined by C. G. Lloyd. No. 8003. On very wet, rotting *Carica Papaya*, Papenu, May 23.

DACRYOMYCETACEAE

Guepinia spathularia Schw.

Plants small, scant, orange colored, branching, tough, gelatinous when moist, 2-3 cm. high, rare. Determined by C. G. Lloyd. No. 8006. On dry guava wood, Punaruu Valley, May 23.

CLAVARIACEAE

Clavaria cyanocephala B. and C.

Plants large, conspicuous, dull yellow, much branched, 8-10 cm. high, uncommon. Determined by J. R. Weir. No. 8086. Upper Fautaua Valley, July 10.

THELEPHORACEAE

Thelephora spathulata (Berk.)

Very small, inconspicuous, upright, branching at tips, 1–2 cm. high, spathulate, petaloid, with short, lateral stipe, surface gray, striate, hymenium even, dark, spores typical, rooting on rotten wood in ground. Determined by C. G. Lloyd. No. 8054. Papeari, June 20. (*Stereum spathulatum* Berk.)

Schizophyllum commune Fr.

Typical of the species. Not abundant, poorly developed. No. 8015. On *Carica Papaya*, Faaa, May 27. Determined by C. G. Lloyd. No. 8033. On a mango pit, Fautaua Valley, June 8.

Placed under Thelephoraceae in accordance with the findings of Essig, Morphology of *Schizophyllum commune* Fr., Univ. Calif. Publ. Bot., vol. 7, p. 472, 1922.

AGARICACEAE

Lepiota chlorospora Copeland

Plants large, conspicuous, white, pileus thin, 10–20 cm. broad, dry, umbonate, margin thin, regular, entire, slightly recurved, annulus present, large, conspicuous, gills free, pale yellowish green when fresh, odor very strong, taste strong but not unpleasant, stipe 10–20 cm. long, central, slender, brittle, cylindrical, smooth, with a slight swelling at base. Determined by V. K. Charles. No. 8013. May 23, Mahina District.

The plants collected were forming a segment of a large circle in sandy soil near the strand line but under coconut palms. Occasionally they were observed elsewhere near the shore in sandy soil after rain.

Pleurotus ostreatus Jacq.?

Pileus 4–6 cm. broad, smooth, white, tough, imbricate, with short lateral stipe, or sessile, rather thin, gills strongly decurrent, odor and taste mild and pleasant, resembling closely American forms but smaller, the spores also smaller than for typical forms; specimens

noted frequently in wounds on leguminous trees along roadsides. Determined by V. K. Charles. No. 8026. Papeete, June.

Miss Charles says of this specimen: "I find no tropical species which exactly describes this specimen. It may be a tropical form of *P. ostreatus* and so called tentatively although the spores are much smaller than for typical *Pleurotus*."

***Pleurotus* sp.**

Plants small, white, sessile, 3-5 cm. broad, flesh thin and tough, growing on dead Hibiscus wood, material scanty. Determined by V. K. Charles. No. 8005. Punaruu Valley, May 23.

***Flammula* sp. ?**

Plants small, 3-4 cm. broad in clusters, rusty, stipe central, 3-5 cm. long, cylindrical, gills free, on rotting wood, inconspicuous. Determined by V. K. Charles. No. 8045. Orofere Valley, Paea District, June 13. Assigned here tentatively.

***Lentinus sajor-caju* Fr.**

Plants single, white or sordid when fresh, drying yellowish brown, 3-5 cm. broad, 5-7 cm. high, centrally stipitate and infundibuliform with a thin recurved margin, gills decurrent and more or less serrate, plants small, inconspicuous and of rare occurrence, on wet, rotting wood. Determined by C. G. Lloyd. No. 8025. On well rotted coconut, near Papeari, June 3. No. 8083. On rotting Hibiscus, Paea, July 15. Lloyd says of 8083: "Unusual as to more unilateral form."

POLYPORACEAE

***Poria vincta* (Berk.) Cooke**

Pale pink or flesh colored when young, becoming dark brown in age, effused over large areas of decaying wood, 2-5 mm. or more in thickness, tubes small, round, with thick mouths, margins usually broad and sterile and lighter in color, common on all kinds of wood but most frequently seen on Hibiscus and coconut. Determined by J. R. Weir. No. 8001. Papenu, May 20. No. 8016A. Taapuna, Punaruu District, May 27. No. 8018. Faaa District, May 27. No. 8051. Fautana Valley, June 30. No. 8065. Paea District, June 12. No. 8084. Papeari District, June 22. No. 8092. Tautira, June 22.

***Poria ferruginosa* (Schrad.) Karst.**

Brown, margin very broad, lighter in color, sterile, tubes 3–5 mm. long, with round, thin, even mouths, stuffed when young, effused over large areas of wet rotting wood, generally of *Hibiscus*. Determined by J. R. Weir. No. 8017. Faava District, May 27.

***Poria crocipora* B. and C.**

Very thin, flesh colored, drying darker, tubes short and angular, margins thin and sterile, lighter colored than mature portions, scant, on wet rotting wood. Determined by J. R. Weir. No. 8064. Papehue Valley, on *Hibiscus*, June 12.

***Poria flavomarginata* (Murr.) Sacc. and Trott.**

Brown, thick, with very long tubes, mouths small and round, effused over large areas of fallen trees in early stages of decay, agreeing with the type except that it has amber colored spores instead of hyaline, conspicuous on *Inocarpus edulis* and *Hibiscus tiliaceus*. Determined by J. R. Weir. Nos. 8088, 8093. Maara River Valley, Papeari, June 22.

***Poria* sp.**

Entire plant brown, thick, with very long tubes, margin narrow, mouths of tubes round, small, thin, regular, effused over large areas of rotting wood, close to *P. Andersonii* E. and E. Determined by J. R. Weir. No. 8063. On rotting *Inocarpus edulis*, Papeari District, Maara Valley, June 20.

***Poria* sp.**

Plants thick, brown, resupinate, on side of log, very small, tubes long, mouths small, irregular and thin. Determined by J. R. Weir. No. 8067. On rotting *Hibiscus*, Paea, June 12.

Weir says: "Have never been able to learn if species named. It is related to some of Langlois's material, *Poria melleopora*, as named by Murrill, but he did not correctly diagnose Langlois's specimens." Collected by Weir in Brazil.

Polystictus meleagris Berk. forma (**P. cuneatiformis** Murr.)

Plants thin, white, imbricate, sessile, upper surface scurfy, rough, with conspicuous zonations, tubes shallow, mouths thin and irregular, 3-6 cm. broad, not common. Determined by J. R. Weir. No. 8011. On rotten *Artocarpus*, Mahina, May 23.

Polystictus vittatus Berk.

Plants conspicuous, 10-20 cm. broad, very thin, sessile or with a short lateral stipe, either smooth or tomentose, variable, often scurfy and zonate, gray above and white below, tubes small, shallow, mouths thick, round; common on wet rotting wood, more frequently on *Artocarpus*. Determined by J. R. Weir. No. 8043. Papeari, June 30. Nos. 8056, 8057, 8057A, 8059. On *Artocarpus*, Papenu, June 9. No. 8089. On *Inocarpus edulis*, Papeari, June 30.

Under 8043, Weir says: "*P. gallo-pavonis subzonalis*, but not *P. gallo-pavonis*, type." *P. gallo-pavonis* B. and Br., *P. subzonalis* C'ke, *P. vittatus* Berk., and *Daedalea pavonia* are distinguishable only by size of the pores.

Polystictus sp.

Plants thin, white, sessile, imbricate, conspicuous broad basal attachment, upper surface rough, scurfy, with slight zonation, margins thin, recurved, tubes shallow, mouths thin, irregular, plants 3-6 cm. broad, not very common. Determined by C. G. Lloyd. No. 8024. On rotting coconut, Papara, May 28. No. 8073. On rotting coconut, Papeari, June 20.

Polyporus caesius Schrad.

Plants very small, sessile, margin dark, tubes very small, white, even, plants 2-3 cm. long, 1 cm. thick, snuggling into small cavities beneath the bark of old trees, apparently rare. Determined by C. G. Lloyd. No. 8074. Papeari, June 22.

Polyporus zonalis Berk.

Plants sessile or with short lateral stipes, 8-10 cm. broad, thick, hard, tough and woody, at base of coconut palms and other trees. Determined by J. R. Weir. No. 8027. Punaauia, June. No. 8066. Arue, July 4.

Polyporus gilvus Schw.

Conspicuous large brown polypore, growing in wound at bases of living trees. Determined by J. R. Weir. No. 8085. On *Rhus taitensis*, Tautira, June 21, spores uncertain.

Polyporus infernalis Berk. forma.

Plants small, stipitate, 2-4 cm. broad, equally high, pileus thin, brown, stipe lateral, lighter colored, plants inconspicuous, resembling a small *Boletus*. Determined by J. R. Weir. No. 8091. On dead wood, Tautira, June 21.

Trametes ostriformis Berk.

Plants small, white, thin, with narrow margin, resupinate, in small, widely scattered patches, on dead dry wood, uncommon. Determined by J. R. Weir. No. 8007. On Hibiscus, Fautaua Valley, May 21.

"This belongs in group of white-gray tropical species, named and renamed by Murrill and others." Weir *in lit.*

Trametes glabrescens Berk.

Plants conspicuous, white, thick, woody, tough, imbricate, sessile, attached either laterally or centrally to host, tubes short, very small, mouths thick, round; considered a rare species. Determined by J. R. Weir. No. 8055. On rotting *Artocarpus*, Faaa, June 7.

Trametes heteromorpha Fr.

Inconspicuous, small, thin, white, with large shallow tubes, mouths thin, irregular; tropical form. Determined by J. R. Weir. No. 8078, on bark of *Stenolobium stans*, upper Fautaua Valley, July 8.

Fomes pachyphloeus Pat.

Plants very large, brown, woody, tubes small, round, mouths thick, uncommon. Determined by J. R. Weir. No. 8036. Growing over fern roots, Fautaua Valley, June 8. No. 8044. Growing from wound in old mango tree, Arue, June 19.

Fomes licnoides Mont.

Small, thick, brown, with distinct zonation, rough and scurfy, tubes long, mouths small, thick, round, spores smooth, dark, globose, 8μ diam. Among fern roots and wet logs. Determined by J. R. Weir. No. 8041. Papehue, June 7. No. 8046. Papeari, June 20.

Weir says: "Has structure of *F. licnoides* Mont. but a peculiar form, will hold under this name until additional material turns up. It comes in the *licnoides-gilvus* group."

Fomes hawaiiensis Forbes.

Plants entirely resupinate, effused over considerable areas on bark of decaying Citrus tree, flesh colored when young, drying a purplish-black, poroid, up to 1 cm. thick, the mouths of tubes very thin, irregular, tubes in our specimen 120 to 160μ in diameter or 6 to a millimeter, margin narrow, thin, fertile, lighter in color, spores scant, globose, hyaline or very light colored, varying from 5 to 7μ in size.

Lloyd thinks this a color form of *Fomes senex*. Our specimens are peculiarly resupinate but *F. senex* is a pileate form from Juan Fernandez Island named by Nees and Montagne. *Fomes hawaiiensis* is also a pileate form. (See figures 598, 599, pp. 259, 260, Synopsis of Genus *Fomes*, Lloyd, Jan., 1915.) Spore and tube measurement agree closely but this is more Poroid in type. Determined by C. G. Lloyd. No. 8040. On rotting Citrus, Papeari, June 20.

Fomes lignosus Klotsch.

Small, sessile or with short lateral stipe, 2-3 cm. broad, 1 cm. thick, hard, tough, woody, surface rough and zonate, tubes short, mouths small, round, plants common, variable. Determined by C. G. Lloyd. No. 8010. On coconut, Mahina, May 23.

Polyporus rigidus Lev.

Very similar to the above but very much larger, 10-12 cm. broad, thinner, stipitate laterally, brown, hard, tough, woody. Determined by C. G. Lloyd. No. 8010B. On coconut, Atiue, May 23.

Ganoderma tornata (Pers.) Bres.

Bracket form, 10–20 cm. broad, 1–2 cm. thick, upper surface brown, hard, polished, more or less zonate, context thin, brittle, white beneath, the tubes long, 1.5 cm., with mouths large round, thick; growing at the base of trees, not common. Determined by J. R. Weir. No. 8022. In swamp on Hibiscus, Papara, May 28. No. 8076. On Citrus, upper Fautau Valley, July 10. Lloyd says 8076 is *Fomes applanatus*. I can see no difference except in size of specimens.

Ganoderma polychromum (Copel.) Murr.?

Small, very hard, tough, and woody, 6–8 cm. broad, 1–2 cm. thick, upper surface varnished, shining black when fresh, under surface flesh colored to pinkish red, laterally attached at base of old coconut palm; young plants not fitting well with the descriptions of known species. Determined by J. R. Weir. No. 8087. Maara plantation, Papeari, June 20. “Interesting plant, not agreeing well with anything I have seen.” Weir *in lit.*

SPHAERIOIDACEAE

Cytospora palmicola B. and C.

Pycnidia on the bracts of young fallen coconuts, often in very large numbers, small, black, of frequent occurrence on the very young nuts which have lain on the ground until dry. Determined by W. W. Diehl. No. 8053. Taapuna, June.

DEMATIACEAE

Sporodesmium sp.

Common black sooty fungus covering large areas of dead dry wood. Determined by V. K. Charles and W. W. Diehl. No. 8037. Paea, June 8.

TAHITIAN ALGAE
COLLECTED BY W. A. SETCHELL, C. B. SETCHELL,
AND H. E. PARKS

BY
WILLIAM ALBERT SETCHELL

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TAHITIAN ALGAE

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The present account includes an enumeration of the specimens of algae collected on a visit to Tahiti in the summer of 1922, together with some references to specimens from the same island distributed by Professor Josephine E. Tilden in her "South Pacific Algae." References to the occurrence of various algae on the shores of or in the vicinity of Tahiti are also included to some extent, but no attempt has been made to render such a list absolutely complete.

MYXOPHYCEAE

COCCOGONALES

Chroococcus turgidus (Kuetz.) Naeg.

Intermingled with various filamentous algae in fresh water on dripping rocks. 5123. Cliffs near Huau, June 5.

Chroococcus schizodermaticus West

Among Scytonema filaments, moist rocks. 5119. Cliffs near Huau, June 5. 5350, 5351. Cliffs near mouth of Papenu River, June 5.

Chroococcus membraninus (Menegh.) Naeg.

On dripping rocks among other gelatinous algae. 5067a. Tahara Mountain, May 24.

Chroococcus minor (Kuetz.) Naeg.

Credited to Lake Vaihria by Grunow (Alg. Novara, p. 29, 1868).

Entophysalis granulosa Kuetz.

With *Calothrix crustacea* Thuret and other Myxophyceae. 5112. Near Huau, June 5.

Aphanothece microscopica Naeg.

On moist rocks among other gelatinous algae. 5351. Cliffs near mouth of Papenu River, June 5. Tilden, South Pacific Algae, 3.

Chlorogloea?

On *Cladophora*. 5161. Tahara Mountain, June 17. Epiphytic in tubercular and confluent masses; cells 1–4 μ diam., 1–1.5 times as long as broad; not definitely arranged in any order; reminding one of *Microcystis parasitica* Kuetz.

Chlorogloea conferta (Kuetz.) S. and G.

On filamentous algae. 5112. On *Calothrix crustacea* Thuret, near Huau, June 5.

Hyella caespitosa B. and F.

5290. In Tridacna shell, in shallow water, near Outo-maoro, District of Punaauia, June 17 (with scanty conidangia).

HORMOGONALES

Oscillatoria princeps Vauch.

On mud, bottom of small stream. 5043. Punaauia District, May. (Filaments 38 μ to 46 μ diam.)

Oscillatoria formosa Bory.

Tilden, South Pacific Algae, 5. (Filaments 6–8 μ diam. and with cells usually 3–4 μ long; slightly coarser and with cells generally shorter than typical material.)

Oscillatoria brevis Kuetz.

Forming a dark blue layer over other algae. 5217. Over *Cladophora*, Punaruu River, June 26. 5089. On dripping rocks, District of Papeari, June 2.

Oscillatoria sancta Kuetz.

Dark blue covering on other algae and on mud, shallow pool. 5072*p.p.* Floor of smaller cave at Maraa, May 29. Filaments 9–12 μ diam.; (var. *caldariorum* Gomont).

Oscillatoria maraaensis sp. nov.

Filamentis sparsis, dilute coeruleo-viridibus, rectis flexuosisque, apice abrupte attenuatis et uncinatis, 8μ diam.; cellulis plerumque 2μ longis, quadruplo diametro brevioribus, cytoplasmate crasse granulato, dissepimentis non granulatis; cellula terminali capitata, rotundata aut abrupte tumida, depresso-spherica; calyptra nulla. (Type Herb. Univ. Calif., No. 261377.)

Seemingly a very distinct species among the "Attenuatae," because of its diameter and distinctly smaller apical cell.

Among other algae in fresh water pool. 5072*p.p.* Floor of smaller Maraa Cave, May 29.

Oscillatoria tahitensis Grunow.

Gomont (Monogr. Oscill., p. 260, repr.) places this among his "Species Inquirendae." The type locality is the mountain lake "Vaihiria." Grunow places his species near *O. juliana* Kuetz., which is in turn also a *sp. inq.* I have seen nothing resembling it.

Phormidium fragile (Menegh.) Gomont.

Intermingled with other algae (marine). 5036. Tafaa Point, uppermost littoral zone, May 19. (Very slender, even for this species.)

Lyngbya majuscula Harv.

In woolly masses, unattached, usually with other algae. 5024*a*, 5033*q*. Tafaa Point, May 19. (Trichomes about 40μ diam., sheath about 4μ diam.) Tilden, South Pacific Algae, 9.

Lyngbya epiphytica Hieron.

Coiling about the filaments of other algae. 5280. On *Asparagopsis Sanfordiana*, near Outo-maoro, July 15.

Plectonema Nostocorum B. and F.?

Among other gelatinous algae. 5351. Roadside, near mouth of Papenu River.

Plectonema terebans B. and F.

5272. In old shell, near Atiue, District of Punaauia, July 11.

Aphanothece microscopica Naeg.

On moist rocks among other gelatinous algae. 5351. Cliffs near mouth of Papenu River, June 5. Tilden, South Pacific Algae, 3.

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Among other gelatinous algae. 5351. Roadside, near mouth of Papenu River.

Plectonema terebans B. and F.

5272. In old shell, near Atiue, District of Punaauia, July 11.

Plectonema purpureum Gomont var. ?

Among *Calothrix pilosa* Harv. 5036. Tafaa Point, May 19.

Symploca laeteviridis B. & F. var. ?

On old corals, uppermost littoral zone. 5035. Tafaa Point, May 19.
(Has the trichome and sheaths of *S. laeteviridis*! Fascicles distinct, coarse, appressed, but 1 to 1.5 cm. long.)

Hydrocoleum lyngbyaceum Kuetz.

Forming gelatinous, dark green patches on corals (particularly old clumps of massive *Porites*). 5038. Tafaa Point, May 19. 5218b. With *Enteromorpha plumosa* Kuetz., on *Sargassum*, Arue Point, June 27. 5242. In shallow pool, scanty, Punaruu Pass, July 11 (occasional filaments in mass of gelatinous material).

Hydrocoleum cantharidosmum Gomont

Forming gelatinous dark green patches on other algae. 5190a. Near Faarapa, Papenu District, June 19.

Microcoleus paludosus (Kuetz.) Gomont.

Among other algae, in shallow pool of fresh water. 5072p.p. Floor of smaller Maraa Cave, May 29.

Microcoleus tenerrimus Gomont.

Among other algae, uppermost littoral zone. 5036. Tafaa Point, May 19.

Nodularia hawaiiensis Tilden

Tilden, South Pacific Algae, 11. The specimens distributed seem to belong to the same species as those sent out under No. 484 of the American Algae, although the trichomes are slightly more slender. The plant seems probably to belong to the genus *Nodularia*, but until spore-bearing plants are found even this will remain uncertain.

Nostoc Linkia (Roth) Bornet

Tilden, South Pacific Algae, 12. (sub. "*Anabaena variabilis*.")

Nostoc rivulare Kuetz.

Tilden, South Pacific Algae, 10. (sub *N. muscorum*.)

Nostoc ellipsosporum Rabenh.

On dripping cliffs among other algae. 5067*a*. Tahara Mountain, May 24.

Nostoc muscorum Ag.

On moist ground, with other gelatinous algae. 5351. Roadside near mouth of Papenu River, June 5.

Nostoc minutissimum Carm.

In minute globular or difform colonies with distinct periderm, among other gelatinous algae. 5123. Roadside cliffs, Tapahi, June 5.

Cylindrospermum licheniforme (Bory) Kuetz.

Forming greenish-black layers on tree trunks. 5122. Near Huau, June 5.

Calothrix pilosa Harv.

On rocks, in extended cespitose layers, uppermost littoral belt. 5033*m*, 5036, 5038. Tafaa Point, May 19.

Calothrix aeruginea Thuret.

On *Cladophora*, forming very short stellate clusters. 5162. Tahara Reef, June 17.

Calothrix crustacea Thuret.

Forming extended patches on rock, uppermost littoral zone. 5112. Near Huau, June 5.

Dichothrix Hosfordii (Wolle) Bornet

Among filamentous algae (*Rhizoclonium*, etc.) on dripping cliffs. 5123. Tapahi, June 5.

Brachytrichia maculans Gomont

In difform, applanate spots, on rocks among *Calothrix crustacea* Thuret. 5033*b*. Tafaa Point, May 19 (not typical!). 5112. Near Huau, June 5.

Brachytrichia Codii sp. nov.

Thallo exiguo, inter utriculos *Codium* nidulante; trichomatibus pauce-aggregatis 3–6 μ diam., ramosis, ramis nunc veris nunc falsis, ultimis in pilis desinentibus, non aut parum ad dissepimenta constrictis, plerumque cylindraceis, rectis aut in modo *Brachytrichiae* geniculatis; cellulis plerumque diam. longioribus dissepimentis plerumque obscuratis. (Type Herb. Univ. Calif., No. 262726.)

Among the utricles of *Codium*. J. Reef near Punaruu Pass, July. While this may simply be a form of *B. maculans* Gomont, its epiphytic character, its lack of a definitely shaped thallus, and its slender filaments with elongated cells and obscured dissepiments lead me to keep it separate, at least until more experience may be obtained as to both species. It certainly seems very different from the plant of my number 5112. I find this species among my collections from Hawaii.

Mastigocoleus testarum Lagerheim

5290. In *Tridacna* shells, in shallow water, near Outo-maoro, District of Punaauia, July 17. 5170f. In various *Melobesia*e, reef at Tahara Mountain, June 17.

Microchaete vitiensis Askenasy

In small patches, cespitose. 5033f. Reef near Outo-maoro, May 19.

Microchaete tapahiensis sp. nov.

Filamentis sparsis, solitariis aut pauce-aggregatis, rectis, flexuosis aut interdum convolutis, epiphyticis, dilutissime coeruleis, usque ad 0.2 mm. longis, 4–4.5 μ crassis, inferne parum latioribus; trichomatibus 3.5–4 μ crassis, cellulis plerumque diam. duplo brevioribus ad dissepimenta non aut leviter constrictis, cellula terminali hemispherica aut oblonga, interdum lente tumida; vaginis achrois, tenuissimis indistinctis; heterocystis singulis aut binis, rarissime trinis, basalibus, inferis et mediis depresso-globosis, 4–5 μ crassis, usque ad 6 μ longis, superis cylindricis, 4–5 μ crassis, usque ad 12 μ longis; hormogoniis 15–18 μ longis, sporis ignotis. (Type Herb. Univ. Calif., No. 261409.)

5045. Among and on filaments of *Scytonema saleyerense*, on leaves of *Cyrtandra Parksii*, wet with drip from cliffs, Tapahi, May 23.

A more slender species than any described; nearest perhaps to *M. naushonensis* Collins in habit and dimensions but with shorter and more slender filaments, shorter cells, and probably of a different color.

Scytonema coactile Montagne.

Among other filamentous algae in fresh water pool. 5067. Tahara Mountain, May 24. 5121. Tapahi, June 5 (only scattered filaments seen).

"Scytonema natans Breb."

This species is credited to Lake Vaihiria by Grunow (Alg. Novara, p. 31, 1868). It is possibly *S. coactile* Mont., since Grunow says that his specimens agree better with Kuetzing's figure (Tab. Phyc., vol. 2, p. 22) than with his description. Kuetzing's *S. natans* is now referred to *Plectonema Tomasinianum* Bornet.

Scytonema polycystum B. and F.

In floccose dull red tufts on other algae. 5033a. Arue Reef, May 19. Known hitherto only from the type locality on the coast of New Caledonia and from the collections of the Siboga Expedition in the East Indies.

Scytonema guayanense (Mont.) B. and F.

On earth, forming symplocoid patches. 5350. Roadside beyond mouth of Papenu River, June 5.

Scytonema ocellatum Lyngbye

Forming a velvety covering on decomposing rocks. 5209. Near Papeivi Pass, June 24.

Scytonema varium Kuetz.

Forming verdigris green patches on dead wood. 5149. Moist banks of the Punaruu River, June 15. 5412. Maara Valley, in the Papeari District, June 29.

Scytonema mirabile (Dillw.) Bornet

Forming dark velvety coatings on rocks and cliffs. 5119. Tapahi, June 5. 5150a. Dry bed of branch of Punaruu River, June 15.

Scytonema saleyerense Web. v. Bosse

Forming seal brown velvety covering on leaves of *Cyrtandra Parksii*, kept moist by spray of small waterfall. 5045. Tapahi, May 23.

CHLOROPHYCEAE

ISOKONTAE

PROTOCOCCALES

Oocystis solitaria var. **rupestris** (Kirch.) Hansg.

Mostly solitary, among other algae. 5123. Dripping cliffs near Huau, June 5.

Scenedesmus bijuga (Turp.) Lag.

Occasional among other algae. 5123. Dripping cliffs near Huau, June 5.

Pediastrum tetras Ralfs

Occasional among other algae. 5067a. On dripping rocks, Tahara Mountain, May 24.

ULOTRICHAE

Enteromorpha chaetomorphoides Boerg.

In low contorted layers or woolly patches. 5109d. Shore between Papenu River and Huau, June 5. R. In shallow brackish pool near Punaruu Pass, July. This is a low, contorted, slender plant, mostly showing only a few longitudinal rows of cells but also approaching the larger, not contorted, simple plant I have placed under *E. tubulosa* Kuetz.

Enteromorpha tubulosa Kuetz.

In erect tufts, coarse and up to 10 cm. high, on stones and shells. 5235. Brackish water at mouth of Maara River, Papeari District, June 29.

Enteromorpha salina var. **polyclados** Kuetz.

Forming a fleece over *Sargassum*, mixed with *Hydrocoleum lyngbyaceum* Kuetz. 5218a. Arue Point, June 27.

Enteromorpha lingulata J. Ag.

In tufts and elongated masses, on stones. 5086. Papawa Harbor, June 1. 5109c. Shore between Papenu River and Huau, June 5. 5282. Reef beyond Auae, June 15. 17, Tilden South Pacific Algae (sub *E. flexuosa*).

Ulva Lactuca f. lacinulata (Kuetz.) Hauck

Plate 7, figs. 1-4

Attached to other algae. 5050. Arue Reef, May 19. 5107. Reef between Papenu River and Huau, June 5. 5154. Reef at Tahara Mountain, June 17. 5249. Reef at Punaruu Pass, July 11. 16, Tilden, South Pacific Algae (sub *U. Lactuca genuina*).

This seaweed is eaten by the Tahitians, who call it "*Rimu Miti*," or "salt seaweed." Montagne (Voy. au Sud Pole, Astrolabe, etc., Bot., vol. 1, p. 32, 1845) has credited *Ulva Lactuca* to "Taiti."

Stigeoclonium lubricum (Dillw.) Kuetz. var.

Elongated, deep green, gelatinous, undulating masses, clothing rocks in small cool rivulet. 5068. Tapahi, May 24.

Gomontia spec.?

5290. In Tridacna shells, in shallow water, near Outo-maoro, District of Punaauia, June 17 (sterile!).

Entoderma Codii sp. nov.

Intra membranas externas utriculorum Codii maculas irregulares ad orbiculares vergentes formans; filamentis e centro irregulariter radiantibus mox in fronde unistratoso coalescentibus, peripherice liberis sed non extra circumferentiam thalli longe projicientibus; cellulis isodiametricis, 6-10 μ diam., late polygonis, terminalibus rotundatis; zoosporangiis e cellulis internis parum majoribus oriendis. (Type Herb. Univ. Calif., No. 262725.)

Seeming a distinct species, without the conspicuous projecting filaments of *E. codicola* S. and G. and with differently shaped terminal cells from those of *E. cingens* S. and G. Endophytic within the outer walls of the utricles of species of *Codium*. J. Punaruu Pass, July. I have found the same species among my Hawaiian collections.

***Pseudulvella Rhizoclonii* sp. nov.**

Thallo filamenta hostis cingente, usque ad 1.5 mm. longis, filamentis radiantibus arcute coalescentibus, centro usque ad 3-4-stratis, marginibus 1-strato composito, hinc illine depresso-hemispherice tumido; cellulis centralibus inferis valliformibus, hinc curtioribus, illinc longioribus, tubercula rotunda facientibus, superis curtis, isodiametricis, rotundis, 9-12 μ in diam. transversali; cellulis marginalibus complanatis, 9-12 μ diam., parum ultra longit. (Type Herb. Univ. Calif., No. 261299.)

This proposed new species is very closely related to *P. americana* (Snow) Wille, but is marine and differs in habit and substratum. The details of the development and structure of the depressed-hemispherical swellings are left for future study. Superficially, this plant resembles *Entoderma cingens* S. and G. and *Ochlochaete Hystrix* Thwaites, but is a true *Pseudulvella*.

Forming more or less elongated thalli encircling the filaments of *Rhizoclonium*. 5104. Reef between Papenu River and Huau, June 5.

***Trentepohlia elongata* (Zeller) DeToni**

Forming orange yellow villose patches on the trunks of trees. 5359. District of Papenu, June 5. 20, Tilden, South Pacific Algae (sub *T. villosa*).

Clearly of the *T. aurea* group, and in dimensions closely approximating Hariot's idea of *T. elongata*. Our specimens are sterile and consequently uncertain, but Tildens No. 20 shows solitary, sessile, mostly lateral globular zoosporangia (24 μ diam.).

***Trentepohlia Wainioi* Hariot**

Hariot (Jour. de Bot., vol. 3, p. 383, 1889) refers here the *Chroolepus flavum* var. *tahitense* Grunow (Alg. Novara, p. 41, 1867).

***Phyllactidium marinum* Grunow.**

Grunow described *Phyllactidium marinum* from specimens growing on "*Valonia Forbesii*" from Tahiti, and De Toni lists it (Syll. Alg., vol. 1, p. 10, 1889) as *Coleochaete marinum*. It may possibly be the same plant as my *Pseudulvella Rhizoclonii*, but Grunow's description of terminal, single or double "spores" seems to indicate a different plant.

SIPHONOCCLADIALES

Rhizoclonium samoense Setchell

Forming intertangled masses or erect tufts.

f. typicum comb. nov.

Setchell, Veg. Tutuila Island, p. 177, fig. 42, 1924

On cliffs above sea level, Tahara Mountain, June 17.

f. arrhizum f. nov.

Filamentis intertextis, rhizoideis nullis.

5104. Reef between Papenu and Huau, June 5; forming a fleece over other algae. 5182. Reef at Tahara Mountain, June 18.

It seems best, in the absence of more exact information concerning *R. ambiguum* (Hook. and Harv.) Kuetz. and *R. Hookeri* Kuetz., to keep *R. samoense* distinct. *R. ambiguum* seems to have multicellular rhizoids and *R. samoense* attains a greater diameter and thickness of wall than is described for either *R. Hookeri* or *R. africanum*, but more exact information and experience is highly desirable.

Rhizoclonium hieroglyphicum (Ag.) Kuetz.

Intermingled with other filamentous algae in fresh or slightly brackish water. 5074. In pool at entrance to principal cave at Maraa, May 29. 5120. In fresh water pool, base of cliff at Tapahi, June 5. 5148. Edge of Punaruu River, June 15.

There appears to be two varieties of this species in the mixtures examined. One is slender, with cells 12–16 μ in diameter and with thin walls, while the larger form ranges from about 20 to 28 μ in diameter and has relatively thicker walls. The cells in each variety vary in length up to about three times as long as broad.

Our larger forms may belong to *R. hieroglyphicum* var. *crassior* Grunow (Alg. Nov., p. 37, 1868) from Lake Vaihiria, Tahiti, although Grunow's measurements (30–35 μ as I estimate them) are not reached by our specimens.

***Rhizoclonium lubricum* S. and G.**

In shallow brackish pool. R. Near Punaruu Pass, July. The plant referred above is mingled with filaments of *Enteromorpha chaetomorphoides*, is about 40μ in diameter, with the cells mostly about three times as long as broad.

***Chaetomorpha basiretrorsa* sp. nov.**

Plate 8, figs. 4-6

Filamentis caespitosis, curtis, supra basim declinatis et crispato-curvatis, basi abrupte retroflexis et rhizoides emittentibus, rarissime supero ramos singulos ostendentibus, aetate provecta liberis et stratos extensos implicatos formantibus; segmentis cylindricis aut lente tumidis, $400-600\mu$ diam., duplo ad triplo longioribus, ad dissepimenta parum constrictis, basalibus usque ad 2 mm. longis, abrupte retroflexis, basi per 2-3 processubus rhizoideis affixis. (Type Herb. Univ. Calif., No. 261301.)

This proposed species resembles *C. antennina* when young and attached but differs in its deflexed habit and peculiarly bent basal cell. When older and free, it resembles *C. spiralis* and *C. torta*, from both of which it differs in all dimensions. It also resembles the unattached plant of the New England coast commonly referred to *C. Picquotiana*, but which is probably not the species described by Montagne (*C. Melagonium?*). It seems to answer to the description given for *C. valida* (Hook. et Harv.) Kuetz. but nothing is known of the base of that species. *Chaetomorpha basiretrorsa* belongs to a different section of the genus from *C. antennina*, which forms erect tufts and whose basal segment is straight, erect, and permanent. I have *C. antennina* from Tutuila, Samoa, but have not met with it in Tahiti.

In pools on reef. 5271. The type locality was in a deep pool, where the single tuft discovered was covered under the fronds of *Sargassum*. Punaruu Pass, July 12. 21, Tilden, South Pacific Algae (sub *Chaetomorpha antennina*; free entangled stage?).

***Chaetomorpha fibrosa* Kuetz.?**

Plate 8, figs. 7, 8

Forming crispate entangled layers over larger, attached algae. 5160. Over corallines, reef at Tahara Mountain, June 17. 5260a. Over *Sargassum*, reef at Punaruu Pass, July 11.

With segments 80–100 μ in diameter and 70–240 μ long, with walls stratified and up to about 12 μ thick, our plants agree with the description of Kuetzing and seem to be more slender and with longer segments than *C. brachygona* Harv. and *C. restricta* Kuetz., at least as I have interpreted the latter in my Vegetation of Tutuila Island (1924, p. 178).

***Pithophora affinis* Nordst.**

Among other algae in fresh water pools. 5074. Pool at mouth of large cave at Maraa, May 29.

Of the two species of our collection, the more slender (48–68 μ diam.) seems to answer the description of Nordstedt's species rather than that of *P. Oedogonia*.

***Pithophora sumatrana* (Mart.) Wittr.**

Among other algae in fresh water. 5119. On dripping rocks, along roadside, between Papenu and Huau, June 5. 5148. Around stones, edge of Punaruu River, June 15. 26, Tilden South Pacific Algae (sub *P. Roettleri*) ?

Coarser plants than those assigned to *P. affinis*, about 100 to 120 μ diam. in the primary filaments, with fairly uniform intercalary cylindrical hypnospores and branches largely if not entirely of one order.

***Cladophora Beneckii* Moebius**

Forming small tufts (1–1.5 cm. high) among other filamentous algae on mud kept moist (wet!) by abundant drip from the overhanging rocks. 5072. Principal cave at Maraa, May 29.

Seemingly very close to if not identical with the species of the Island of Java as described by Moebius in the Ber. deutsch bot. gesell. of 1893 (p. 120, pl. 9, fig. 8, *a-g*), but slightly more slender and with possibly sparser branching.

***Cladophora insignis* (Ag.) Kuetz. var. ?**

On stones in dark green tufts, later floating in fresh water. 5216. Punaruu River (near the bridge), June 26.

Elongated, very sparingly branched, with branches strict; primary filaments 100–120 μ in diameter; branches as slender as 60 μ in diameter; segments all much elongated; walls thin; slightly constricted at the dissepiments; apparently different from *C. chartacea* Grunow in color, habit, and texture.

***Cladophora patentiramea* (Mont.) Kuetz.**

Plate 9

Forming caespitose, spongy, light (grayish) green tufts. 5138. Cast ashore, Tiarei District, June 9.

To this species, of which Tahiti is the type locality, I assign a single specimen, which seems to correspond to the descriptions and to the figures given by Kuetzing (Tab. Phyc., vol. 4, pl. 60, I). Reinbold (Monogr. Siboga Exp., LIXa, p. 83) has detected this species among the collections of the Siboga Expedition in the East Indies.

***Cladophora socialis* Kuetz.**

In low, dark green, spongy masses. 5215. Floating in small inlet beyond the village of Tautira, June 24.

I refer to this species, whose type locality is Tahiti, several specimens of a single collection having all the characteristics ascribed to it by Kuetzing and illustrated by him (Tab. Phyc., vol. 4, pl. 71, I). Reinbold (Monogr. Siboga Exp., LIXa, p. 82) has doubtfully referred specimens from the Lucipara Islands to this species. In ours, the rhizoidal filaments are abundant. Boergesen has detected this species among Skottsberg's Easter Island collections (cf. Boergesen, Marine Algae from Easter Island, p. 249, 1924).

***Cladophora leucobryoides* sp. nov.**

Filamentis erectis, usque ad 2 cm. altis (in spec. unico typico), dense et paralelliter in caespites extensas(?) aut late depressosphaericas, basi affixis, aggregatis intertextisque, glaucescente viridibus; filamentis primariis infero usque ad 52μ diam., segmentis usque ad 180μ longis, parietibus usque ad 12μ crassis, hyalinis, stratosis, segmentis ultimis usque ad 20μ diam., terminantibus apice obtuse rotundatis; ramis numque oppositis, plerumque secundatis, nunc longis, erectis, nunc longe rhizoideis descendentibus intertextisque. (Type Herb. Univ. Calif., No. 233473.)

The superficial resemblance in color and compactness to masses of the genus *Leucobryum* has suggested the name for this proposed new species. It is clearly of the *Aegagropila* type and bears no resemblance whatever in habit, at least, to *C. heteronema* Kuetz., as I interpret it. The plant distributed by Tilden (sub No. 24) is, in my copy, so distinct in habit and color from anything known to me that I feel justified in proposing it as new. The cushions are much

more dense than those of any of the *Spongomorpha* group, even exceeding those of *C. uncialis* or of its variety *lanosa*. The cushion of *C. leucobryoides* in its dried state is distinctly and firmly felt-like.

Habitat unknown. 24, Tilden, South Pacific Algae (sub *Cladophora heteronema*).

***Cladophora inserta* Dickie**

f. ***typica*** comb. nov.

Ramulis ultimis erectis.

The type of *C. inserta* Dickie (Dickie wrote the specific name with a "c") is a plant of irregular (not globose) outline and with the ultimate ramuli straight and not curved. It belongs to the group of marine species with zigzag axes and ramelli in more or less distinct pinnae, a habit group including *C. fascicularis* (Mert.) Kuetz. (West Indies), *C. mauritiana* Kuetz. (Mauritius), and probably some others including *C. pinniger* Setchell (Samoa)

C. inserta Dickie comes nearest to *C. mauritiana* of Mauritius, but has much more slender ramelli than has that species. *C. pinniger* Setchell may prove to be only a lax form of *C. inserta*.

Forming low, light yellow green tufts over other algae. 5162. Shallow pools in reefs at Tahara Mountain, June 17.

f. ***ungulata*** (Brand.) comb. nov.

Plate 22, fig. 1

Ramellis ultimis plus minusve curvatis.

Cladophora mauritiana var. ***ungulata*** Brand.

Bot. Centralbl. Beihefte, vol. 18, p. 180, pl. 5, figs. 10, 11, 1905.

Brand founded this form on specimens collected on the Island of Hawaii by Josephine E. Tilden. While I have not seen the type specimen of *C. mauritiana*, the paratypes in Herb. Kew and in Herb. Harvey at Trinity College, Dublin, show plants of similar habit but with the ultimate ramelli suddenly reduced and about 35μ in diameter (of the terminal segments), while f. *ungulata* has them gradually reduced, much more slender in general appearance, and about $18-20\mu$ in diameter in the apical segments. Tilden has distributed the Hawaiian plant of f. *ungulata* as No. 455 of her American Algae, under the name of *C. mauritiana*. Her Hawaiian *C. inserta* (American Algae, No. 456) has the appearance of being an entirely different

plant from that of Dickie (*vide* type specimen in British Museum of Natural History). It is not possible for me to determine what relationship there may be between Brand's *C. glomerata* var. *pusilla* (Bot. Centralb., Beih., vol. 18, p. 5, figs. 6–9, 1905) and *C. inserta*. Brand's figures and his mention of Dickie's species in connection with his variety suggests that it may be a small form of *C. inserta*. The terminal segments vary much in length, often even within the same pinnules.

In short, pale green, often more or less globose tufts on other algae. 5108. Reefs between Papenu and Huau, June 5. 5250. Reef at Punaruu Pass, July 11. D. Reef at Punaruu Pass, late July.

***Cladophora rhadina* sp. nov.**

Plate 10, fig. 1

Filamentis flaccidis, lubricis, dilute-viridibus, flaccidis, tenuissimis, pencillato aggregatis, usque ad 3–4 dm. altis; filamentis primariis, circa 100μ diam., segmentis 400μ aut ultra longit.; ramellis ultimis $12\text{--}16\mu$ diam., segmentis usque ad 280μ longit., apice obtuse rotundatis; ramis inter se longe distantibus virgatis, strictis, solitariis, ultimis curtis secundisque in crassitudine ordine utro gradatim decrescentibus sed e basi ad apicem longe et insensim attenuatis, longissimis, ultimis curtis gracilioribusque. (Type Herb. Univ. Calif., No. 261235.)

5212. Floating near causeway at Port Phaeton, Afaahiti District, June 24.

The species proposed above as new is related to *C. nitida* Kuetz., *C. longicoma* Kuetz., *C. trichocoma* Kuetz., *C. Hariotiana* Howe, and *C. Stimpsonii* Harv., but has decidedly more slender filaments than any of these. It agrees more nearly with the specimens distributed as *C. Stimpsonii* Harv. in the Phycotheca Boreali Americana (No. 729) from San Diego, California.

The Californian plants referred to *C. Stimpsonii* are more slender than the specimens referred by Yendo to that species, while our plants and those from San Diego agree in having the primary filaments about 100μ in diameter and the apical segments of the ultimate ramuli as narrow as 12μ to 16μ . Yendo's Japanese plant (in Herb. Univ. Calif.) shows primary filaments of 120μ or more below and ultimate cells of about 40μ in thickness. In habit it seems close to *C. longicoma* Kuetz., but the trichomes of that species are described as rigid and presumably of a very different texture from those of our plant.

Cladophoropsis sundanensis Reinbold

Forming rigid and compact low, flattish cushions, varying from light to dark green. 5048. Arue Reef, May 23. 5155, 5160. Reef at Tahara Mountain, June 17.

Our plant agrees with Reinbold's description and figure in having one dichotomy below with secund branching above, but is slightly coarser, with its main filaments up to 120μ in diameter.

Cladophoropsis infestans Setchell

Forming extended soft patches of a dark green color, mixed with *Jania*. 5151. In pools on reef at Tahara Mountain, June 17.

The Tahitian plant is slightly more slender than the Samoan plant and forms a closer layer or soft turf, but branching of all orders is the same in both plants.

Cladophoropsis herpestica (Mont.) Howe.

Plate 8, fig. 1

Forming coarsely entangled masses. 5258. On reef at Punaruu Pass, July 11. A. Same locality later in July.

Our plant seems to agree with all that M. A. Howe (Mar. Alg. Peru, p. 31, 1914) has said as to the characters of this species and the reasons he assigns for keeping it distinct from *C. Zollingeri* (Kuetz.) Boerg. seem to justify its separation.

Boodlea kaeneana Brand.

Plate 7, fig. 5

Bot. Centralbl. Beih., vol. 18, p. 190, pl. 6, figs. 36-39, 1905.

B. composita f. *irregularis* Brand, Ber. deutsch bot. Gesell., vol. 29, p. 145, 1911.

Tilden, South Pacific Algae, No. 25.

Brand's idea of *Boodlea composita* (Harv.) Brand, while correct as to generic relations, seems confused as to other essential matters. In the first place, the specific name should be credited to Harvey alone, not to "Hooker fil. et Harvey" as is usually the case. In the second place, the type came from Mauritius, not from Hawaii. Finally, Brand's idea of *B. composita* seems to have been derived not from a study of a specimen of the type collection, but from Hawaiian specimens, none of which accessible to me shows the very regular and

almost constant opposite branching such as is shown in Kuetzing's figure (Tab. Phyc., vol. 4, pl. 67, fig. B, 1854). The branching in all the Hawaiian and Tahitian plants I have seen is either single (but not so regularly so as is shown by the type of *B. coacta* (Dickie) Murray, Japan, Chall. Exp.) or double, but, nevertheless, not opposite, both branches or branchlets arising together from one and the same side of the supporting filament. The basal segments of *f. irregularis* are very much elongated and often naked, giving the plant something of the appearance of *B. struveoides* Howe. So far as I am able to determine there is no distinguishing mark between *B. kaeneana* of Hawaii and *B. composita f. irregularis* of Tahiti, and neither is the true *B. composita* of Mauritius.

Forming extended spongiose patches of a yellowish green color.
5214. Floating, Papeivi Pass, June 24. 25, Tilden, South Pacific Algae (sub *Boodlea composita irregularis*).

Microdictyon Montagnei Decaisne

Among other algae, scanty. 5033j. Reef at Tafaa Point, May 19.

I have followed Reinbold (Siboga Exp., Monogr. 59a, p. 67, 1913) in the choice of the name. The scanty material of our collection has "tenacula" of the *Boodlea* type and in other respects accords with the descriptive remarks of Reinbold. Our scanty material agrees with Harvey's No. 89 of the Friendly Islands Algae. Incidentally, it may be remarked that the type locality of *Microdictyon umbilicatum* (Vellay) Zanard is New South Wales and probably near Port Jackson and not in the Hawaiian Islands as frequently stated (cf. Setchell, Univ. Calif. Publ. Bot., vol. 13, p. 101, 1925).

Dictyosphaeria favulosa (Ag.) Decaisne

On stones (lime) among corallines and with *Halimeda simulans* M. A. Howe. 5254a. Reef at Punaruu Pass, July 11. 5276. Reef at Punaruu Pass, July 12. (Plants of both numbers early becoming hollow.)

Dictyosphaeria australis sp. nov.

Plate 8, figs. 9, 10

Thallo irregulari et difformi plus minusve applanato, pulvinuliformi, solido, varie lobato, dilute viridescente et glaucescente, usque ad 4 cm. et ultra diam. et 1.5 cm. et ultra alto, firmo cartilagineoque, infero per segmenta rhizoidea sparsa affixo; segmentis in magnitudine variabilibus, 0.5 mm. usque ad 1 mm. et parum ultra diam., polygonorotundis; spinis in cavitatibus cellularum e parietibus projicientibus 60–88 μ longis, sparsissimis et rarissimis. (Type Herb. Univ. Calif., No. 261244.)

Dictyosphaeria Versluysii Setchell, Veg. Tutuila Is., p. 176, 1924 (not of Weber-van Bosse).

This species seems abundant in Tahiti and reasonably so in Samoa. I referred the Samoan (Tutuila) plant to *D. Versluysii* Weber-van Bosse, noting the difference in intracellular spines both as to abundance and length, since I had no adequate material for comparison. Since that time I have collected and studied a *Dictyosphaeria* at Waikiki, Oahu, and find that it answers fully to Weber-van Bosse's description. I judge, therefore, that true *D. Versluysii* does occur in Hawaii and that the Samoan and Tahitian plants are of a different species. Our specimens do not agree with the descriptions either of *D. van Bosseae* Boerg. or of *D. intermedia* Weber-van Bosse.

5224. Type collection, among low corallines and other tufted algae, Arue Reef, June 27. 5048a. Arue Reef, May 23. (Probably common, since the solid form was frequently noticed, even when no collections were made.)

Valonia ventricosa J. Ag.?

Solitary or gregarious on the reef among other algae. 5048b. Arue Reef, May 23. 5083. Fringing reef at Fareute Point, Papeete, May 30. 5167. Reef at Tahara Mountain, June 17.

Our plants differ from *V. Forbesii* Harv. in being nearly globular and not distinctly pyriform. *V. Forbesii* is credited to Tahiti by Grunow (Alg. Novara, p. 35), but he makes the comment "Forma maxima subsessilis," which applies to the plants we feel may better be assigned to *V. ventricosa*. Weber-van Bosse is of the same opinion (Siboga Exp., Monogr. 59a, pp. 59, 60, 1913). One of our dried specimens is 5 cm. high and 4.5 cm. in diameter, attached in at least two basal areas by slender rhizoidal segments which seem to penetrate the crustaceous coralline on which the specimen grew.

Valonia fastigiata Harv.

Forming patches 15 cm. or more across and 5 cm. or more thick, in shaded pools well towards the edge of the reef. 5277. Punaruu Pass, July 12. E. Same locality later in July.

Neomeris van Bosseae Howe

Solitary or gregariously scattered in pools. 5111. Reefs between Papenu and Huau, June 5. 5266. Reef at Punaruu Pass, July 11. (Both collections determined by Dr. M. A. Howe.)

SIPHONALES

Bryopsis Harveyana J. Ag.

Forming dense tufts, fluctuating with the current in runways well down in the littoral zone. 5185. Reef at Tahara Mountain, June 17.

The Pacific plant, of Tonga, Samoa, and Tahiti, does not correspond exactly to that of the West Indies, but more careful study of a large series of specimens is needed for detailed comparison. The insertion of the ramuli in two series of two ranks each is found in all the Pacific plants and the same seems true of the West Indian plant, but I have little material for comparison.

Chlorodesmis comosa Harv. and Bail.

In bright yellow green silky tufts, exposed to heavy surf. 5048c, 5051a, Arue Reef, May 23. 5053a. Barrier Reef off Papeete, May 26. 5165. Reef at Tahara Mountain, June 17. 5174. Dark green, turf-like, on shaded rocks, Tahara Mountain, June 17 (basal portion). 5219. Arue Reef, June 27.

The common species of the exposed reef rims seems to be the same as that distributed by Harvey from Tonga (Friendly Islands, No. 90). There seems to be a general overlooking of the original place and date of publication, viz., Proc. Boston Soc. Nat. Hist., vol. 3, p. 373, 1851. The type locality is in the Fiji Islands. Our plant is presumably the *Rhytisiophon tahitense* Brand (Ber. deutsch. bot. Gesell., vol. 29, pp. 138-141, pl. 7, figs. 1-8, 1911) or *Chlorodesmis tahitensis* (Brand) Brand (*ibid.*, pp. 606-611, text figs., 1911), but I do not find that the distinctions claimed by Brand are sufficiently constant to separate his species satisfactorily from that of Harvey. Grunow also credits this species to Tahiti (Alg. Novara, p. 35, 1868).

Avrainvillea lacerata (Harv.) J. Ag.

In extended patches in deep shaded holes in basalt rocks, upper littoral zone. 5110. On wave benches near Faarapa in the Papenu District, June 5. 5200. In the same general locality, June 19.

Our specimens agree better with var. *robustior* A. and E. S. Gepp than with var. *typica*. They may belong to a distinct species. The "trunks" and "branches" are heavier and the fronds are thicker and less lacerate than in Harvey's *Udotea lacerata* (No. 86 of the Friendly Islands Algae). On the other hand, the filaments are not twisted torulose as in *A. amadelpha* (Mont.) Gepp.

Halimeda simulans M. A. Howe

Forming tufts in sand or on sandy rocks. 5080. In sand on fringing reef at Fareute Point, May 30. 5129. In sandy mud, Fareute Point, June 5. 5254, 5246. Well out on reef at Punaruu Pass, July 11.

Dr. M. A. Howe has examined samples of all my numbers and pronounced them indistinguishable from West Indian forms, and states that this is the first record of the occurrence of the species in the Pacific Ocean.

Halimeda tridens (Sol.) Lamour. f. *ovata* (J. Ag.) M. A. Howe

In small tufts or clumps, nestling into hollows in the reef. 5023, 5031a, 5033p. Tafaa Point, May 19. 5229. Arue Reef, June 27.

These were examined by Dr. M. A. Howe, who states that they agree with a photograph of J. G. Agardh's type of *H. incrassata* f. *ovata* from Noukahiva in the Marquesas Group.

Halimeda discoidea Decaisne

Among other calcareous algae. 5008. Arue Reef, May 19.

Dr. M. A. Howe considers our plant a small form of this species.

Halimeda macroloba Decaisne

Among other algae. 5255. Reef at Punaruu Pass, July 11.

The determination is by Dr. M. A. Howe.

Halimeda Opuntia (L.) Lamour.

In irregular lax clumps on rocks. 5004. Arue Reef, May 19. 5031. Tafaa Point, May 19. 5079. Fringing reef at Fareute Point, May 30. 5101. Reefs between Papenu and Huau, June 5. 29, Tilden, South Pacific Algae.

Our Tahiti plants under No. 5101 are forms approaching *f. minor* Vickers, and those under No. 5004 approach what passes for the typical form, according to the opinion of Dr. M. A. Howe. Grunow credits *H. Opuntia* to Tahiti (Alg. Novara, p. 35, 1868).

Codium coronatum sp. nov.

Plate 10, figs. 2-5; plate 11, figs. 2, 3; plate 12, figs. 1, 5

Thallo effuso aut applanato-foliaceo, basi angusta elongataque affixo, varie undulato-cristato, substantia molli, atro ad dilute viridi, usque ad 6-7 cm. longo et 1.5-2 cm. alto; utriculis e basi ramosis, late cylindrico-clavatis, junioribus angustioribus, supero parum capitato tumidis, adultioribus latioribus, supero gradatim inflatis, apice rotundatis aut late conicis 600-700 μ longis, 80-300 μ latis; pilis in 1-4 verticillis, tertium superum utriculorum circinantibus, basibus incrassatis; membranis utriculorum externis leviter incrassatis, usque ad 12 μ crassis, rarissime leviter umbonatis, externo et interno levibus; filamentis internis parvioribus 20-25 μ crassis; gametangiis (in No. 5241a) apud medium utriculorum affixis, anguste ellipticis, 123-150 μ longis, 25-60 μ latis, successive ex infero sursum generatis. (Type Herb. Univ. Calif., No. 261420.)

This species in its effuse (earlier?) condition resembles other of the Adhaerantia group, but in its "coxccomb" (later?) state it is distinct from all described species. Its nearest ally is *C. arabicum* Kuetz., so far as we may judge from published data (cf. C. O. Schmidt, Beitr. zur Kennt. der Gatt. Codium, pp. 30, 31, fig. 11, 1923), in habit (?) and in shape and details of thickening and hair structures of the utricle as well as in dimensions of the gametangia.

Affixed to other algae. 5240, 5241a. Reef at Tahara Mountain, July 9 (with gametangia). 5221. Arue Reef, June 27 (sterile).

Codium coronatum var. **insculptum** var. nov.

Ut in plantis typicis *Codii coronati* sed membranis externis, utriculorum plerumque interne insculptis foveolatisque. (Type Herb. Univ. Calif., No. 261421.)

While there seem to be some other slight variations from the typical form as to shape of utricle, yet none seems constant, not even the sculpturing of the inside of the outer membranes of the utricles. In some specimens practically all of the membranes concerned show these markings. This variety bears the same relation to its species as does the var. *cribrosum* M. A. Howe to *Codium intertextum* Collins. Our species and variety, however, are both so different in habit and structure from *C. intertextum* and its variety as to need no extended comparison. Similarly, *C. intertextum* and its variety seem certainly distinct from *C. adhaerens* (Cabr.) Ag. (cf. however, C. O. Schmidt, Beitr. zur Kennt. der Gatt. *Codium*, pp. 26, 28, 1923) both in habit and in structure.

On other algae. 5051c. Arue Reef, May 30.

Codium taitense sp. nov.

Plate 12, figs. 3, 4

Frondibus cylindricis tenuibus, 2-3 mm. diam., usque ad 5-6 cm. longis, dichotomis, repentibus, hinc illinc per fasciculos rhizoideos affixis, dilute viridibus; utriculis anguste pyriformibus, 400-600 μ altis, 100-200 μ latis et rotundis usque ad fornicatis et umbonatis, membranis externis incrassatis, 4-11 μ crassis; pilis utriculorum circa apicem latem, singulis aut paucis in circulo positis; gametangiis ignotis. (Type Herb. Univ. Calif., No. 261371.)

This species belongs to the *Codium tenue* group of low, slender rather regularly dichotomous species, but is decumbent rather than erect in habit, with utricles more slender (mostly below 150 μ diam.), less flattened on top, and with membrane thicker (often even umbonate) than any of the other species referred to the group.

Among other algae. 5102. Reefs between Papenu and Huau, June 5.

Codium bulbopilum Setchell

Plate 11, fig. 1; plate 12, fig. 2

The numbers reported as probably belonging to this species all belong to the *Codium tenue* group of low, regularly dichotomous slender species with broad cuneate-balloon shaped utricles. In this group we may place *C. tenue* Kuetz. and *C. Geppii* Schmidt, along with *C. bulbopilum*, if that be proven a distinct species. *C. Muelleri* Kuetz. differs in habit and *C. taitense* just described, differs in its narrower utricle, in which however, it approximates *C. Geppii*. *C. bulbopilum* differs from *C. taitense* in utricle dimension and thin external wall, from *C. Geppii* in having decidedly broader utricles (up to 400μ in diam.) and from *C. Muelleri* in habit and size of utricles. It also has a single and fairly regular circle of hairs on the older utricles just at their broadest portions, i.e., around the top. Gametangia occur only in No. J. They are broadly ellipsoidal, bluntly apiculate, and measure $135\text{--}200\mu$ in length by $45\text{--}60\mu$ in breadth. The type of the species from Tutuila in Samoa was a young plant but shows the same essential characters as the Tahitian.

Among other algae in pools. 5114. Reefs between Papenu and Huau, June 5. 5181. Reef at Tahara Mountain, June 18. 5241. Reef at Tahara Mountain, July 9. J, Q. Reef at Punaruu Pass, July.

Ostreobium Reineckei Bornet

5232, 5234d. In crustaceous calcareous algae, reef at Arue Point, June 27. 5272. In old shell, near Atiue, District of Punaauia, July 11.

Caulerpa Webbia (Mont.) Mont.

Under *Sargassum* on exposed reef. 5251, 5270. Reef at Punaruu Pass, July 11, 12. (Determined by Dr. Anna Weber-van Bosse.)

Caulerpa sertularioides (Gmel.) Howe

In coral mud on reef flat. 5291. Protected fringing reef at Auae, July. (Determined by Dr. Anna Weber-van Bosse). Grunow credits this species to Tahiti (Alg. Novara, p. 34, 1868, sub *C. plumaris*).

Caulerpa Freycinetii Ag.var. **typica** Weber-van Bosse

Crawling over reef. 5046, 5051, 5055. Arue Reef, May 23. 5049. Pipini, Arue District, May 23. 5106. Reefs between Papenu and Huau, June 5. 5195. Wave benches at Faarapa, June 19. (Determined by Dr. Anna Weber-van Bosse.) Grunow (Alg. Novara, p. 34, 1868) credits this species to Tahiti.

f. **spiralis** Weber-van Bosse

5054. Reef at Pipini, Arue District, May 26. (Determined by Dr. Anna Weber-van Bosse.)

Caulerpa cupressoides (Vahl) Ag.var. **Lycopodium** (J. Ag.) Weber-van Bosse

5105. In small pools on reefs between Papenu and Huau, June 5. (Determined by Dr. Anna Weber-van Bosse.)

f. **amicorum** (Harv.) Weber-van Bosse

5198. On wave benches at Faarapa, June 19. (Determined by Dr. Anna Weber-van Bosse.)

f. **elegans** (Crouan) Weber-van Bosse

5199. On wave benches at Faarapa, June 19. (Determined by Dr. Anna Weber-van Bosse.)

Caulerpa racemosa (Försk.) J. Ag.var. **clavifera** (Turner) Weber-van Bosse

5113. In pools, basaltic rocks between Papenu and Huau, June 5. 5197. Wave benches near Faarapa, June 19. (Determined by Dr. Anna Weber-van Bosse.)

Caulerpa chemnitzia Esper.

5009, 5010. Arue Reef, May 19. (Determined by Dr. Anna Weber-van Bosse, "versus *C. peltata*.") 5275. Reef at Punaruu Pass, July 11. (Determined by Dr. Anna Weber-van Bosse, "versus *C. peltata*.") 5222. Outer reef at Arue Point, June 27. (Determined by Dr. Anna Weber-van Bosse, "versus *C. peltata imbricata*.")

Caulerpa peltata (Turner) Lamour.

5196. In dense tufts, wave benches near Faarapa, June 19.
5159. Densely intertwined with *Cheilosporum*, reef at Tahara Mountain, June 17. 5274. In deep crevice in *Porolithon* belt, reef at Punaruu Pass, July 11. (Determined by Dr. Anna Weber-van Bosse.)

I have not quoted the species of *Caulerpa* mentioned in the paper by Dr. Anna Weber-van Bosse entitled "Note sur les *Caulerpa* de l'île Taiti," etc. (*Annals de l'Inst. Ocean.*, vol. 2, fasc. 1, pp. 8, pls. 1, 2, 1910), since, so far as I am able to trace the localities, none is accredited to the Island of Tahiti proper, but all are from atolls of the Tuamotu Archipelago except the single species from Australia.

MELANOPHYCEAE

PHAEOSPOREAE

SPHACELARIALES

Sphacelaria furcigera Kuetz.

Common on other algae and on old corals. 5267. Reef at Punaruu Pass, July 11 (with propagula only).

Sphacelaria taitensis sp. nov.

Plate 13, figs. 1-3

In caespitibus extensis, caespite quoque hemispherico, ad substrata solida affixis luteo-fuscis, usque ad 1.5 cm. altis; filamentis erectis, basi e filamentis curtis stolonoides in disco irregulari coalescentibus generatis, supero alterne aut secunde ramosis; filamentis primariis basi 40-60 μ , apice 32 μ diam., articulis basalibus 54-64 μ , terminalibus circa 32 μ longis, basalibus 4-5, terminalibus 1-2 dissepimenta verticalia a latere viso ostendentibus, dissepimentis transversalibus secundariis abeuntibus; propagulis a latere visis late triangularibus, 120-260 μ altis (stipite gracili, 60-80 μ longo et 3-5-cellulari incluso) 120 μ latis (trans cornua), cornuis 2, quoque 3-cellulari, gracilibus, leviter sursum projicientibus; pilis, zoosporangiis et gametangiis, nondum visis. (Type Herb. Univ. Calif., No. 262669.)

The proposed new species belongs to the group of South Pacific species, *S. cornuta*, *S. novae-hollandiae*, and *S. novae-caledoniae*. It approaches the last in dimensions but has different propagula, which

in turn approach those of *S. cornuta* in shape, but the main portion is broader while the horns are shorter, possibly stouter, and more suddenly tapering.

5252. Forming extended patches made up of hemispherical tufts on the smooth reef surface, in shallow pools, reef at Punaruu Pass, July 11.

ECTOCARPALES

Ectocarpus indicus Sonder

In tufts, up to 4 or 5 cm. high. 32, Tilden, South Pacific Algae (sub *E. Duchassaingianus*).

In accordance with the opinion expressed in my account of the algae of Tutuila Island (Veg. Tutuila Island, pp. 169, 170, 1924), I have referred No. 32 of Tilden's South Pacific Algae to *E. indicus* Sonder rather than to *E. Duchassaingianus* Grunow.

Ectocarpus breviarticulatus J. Ag.

In closely intertwined tufts on other algae. 5116b. On *Laurencia*, on reefs between Papenu and Huau, June 5. 5166. On *Chnoospora*, reef at Tahara Mountain, June 17.

Ectocarpus gonodioides S. and G.

f. **minor** forma nov.

F. minor in filamentis gametangiisque; filamentis basi 12–15 μ diam., supero 6–8 μ ; gametangiis forma ut in speciei, sed 48–66 μ longis, 9–18 μ latis. (Type Herb. Univ. Calif., No. 262724.)

Forming minute tufts with colorless filaments deeply penetrating among the utricles of *Codium bulbopilum*. J. Reef at Punaruu Pass, July.

This plant, while agreeing with *E. gonodioides* in habit, form, mode of growth, and in penetrating into the substance of a *Codium*, yet differs sufficiently in dimensions to be recorded as a distinct form or possibly variety.

Ectocarpus van-Bosseae Setchell and Gardner

Forming a tomentosoid layer on *Sargassum* and *Laurencia flexilis*, intermingled with the following species. 5190. Faarapa, District of Papenu, June 19.

The Tahiti plants have slightly more slender filaments than has the typical form described from Tutuila.

Ectocarpus Duchassaingianus Grunow

Intermingled with the previous species. 5190. Faarapa, District of Papenu, June 19. The Tahitian plant has short megagametangia but seems to belong to the same species as the plants from Tutuila (cf. Setchell, Carneg. Inst. Wash., Publ. No. 341, pp. 170, 171, fig. 35, 1924).

Ralfsia expansa J. Ag.

Forming dark reddish brown expansions of considerable extent, 300–400 μ thick, over portions of the reef surface, but unfortunately sterile in all our specimens. The thallus structure agrees with the descriptions and figures of Weber-van Bosse (Siboga Exp., Monogr. 59a, pp. 146–147, fig. 45, 1913). 5067. Outer belt of reef at Arue Point, May 24. 5171, 5179. Reef at Tahara Mountain, June 17. 5234a. Reef at Arue Point, June 27.

Colpomenia sinuosa**f. typica** S. and G.

On other algae; credited to Tahiti by Grunow, in Alg. Novara, p. 49, 1868, sub *Asperococcus sinuosus*. 5047. Arue Point, May 23. 5164. Tahara Mountain, June 17.

f. expansa Saunders

5210. Washed ashore near Papeivi Pass, June 24.

f. tuberculata (Saunders) S. and G.

On rocks or reef surface. 5012. Reef at Arue Point, May 19. 5257. Reef at Punaruu Pass, July 11.

Hydroclathrus clathratus (Bory) M. A. Howe

Scattered or gregarious over considerable stretches of exposed reef surface, often forming a belt with the following species. 5002. Abundant, reef at Arue Point, May 19. 34, Tilden, South Pacific Algae (sub *H. cancellatus*).

This species was much more abundant in May and early June than late June and July, when it became scarce. Montagne (Voy. au Pol. Sud., Bot., pl. cell., p. 42, 1845, sub *H. cancellatus*) credits this species to Tahiti.

Chnoospora pacifica J. Ag.

Forming a belt, mixed with the preceding species, on exposed fringing reefs. 5003. Reef at Arue Point, May 19. 5099. Reefs between Papenu and Huau, June 5. 5166. Reef at Tahara Mountain, June 17.

Grunow (Alg. Novara, p. 25, 1868) credits *C. fastigiata* var. *pacifica* and *C. pannosa* to Tahiti (Jour. Mus. Godeffroy, Heft VI. p. 25, 1873-1874).

LAMINARIALES

Macrocystis angustifolia Bory

This species has been credited to Tahiti by Grunow in his account of the Algae of the Novara Expedition (1868, p. 51). It seems very unlikely that it grows in Tahiti and the specimen may have been floating somewhere between Chili or New Zealand and Tahiti.

Lessonia Suhrii J. Ag.**Lessonia nigrescens** Bory

These are two other species of the western coast of South America, credited to Tahiti by Grunow in the Novara "Algae" (1868, p. 51). As in the preceding case, we question the actual finding of these species on the shores of Tahiti, at least as growing there.

CUTLERIALES

***Aglaozonia pacifica* sp. nov.**

I find what seems clearly to be a species of this genus and probably the non-sexual generation of some species of *Cutleria*, possibly of *C. pacifica* Grunow (Jour. Mus. Godeffroy, Heft VI, p. 25, 1873-1874), described from the Island of Upolu, Samoa. It is irregularly orbicular closely applied to the *Porolithon* substratum which it penetrates by moniliform rhizoids (similar to those of *A. canariensis*, as illustrated by Boergesen in "The Marine Algae of the Danish West Indies, part 2, p. 194, fig. 150a, 1914). It is dark brown, smooth above, resembling in general *Zonaria variegata*. The sterile portion of the thallus consists of a central layer of larger cells, on each side of which are four layers of flattened cells, exactly corresponding to the section of *Zonaria latissima* Kuetz. (Tab. Phyc., vol. 9, pl. 75, fig. I, c, 1859), with which our plant may be identical. The growth is from a peripheral row of cells as in Kuetzing's plant (*loc. cit.*, fig. I, b) and the habit somewhat resembles that of *Z. latissima* (cf. Kuetzing, *loc. cit.*, fig. I, a). What seem to be extensive and not distinctly delimited incipient sori are present and consist of palisade-like rows of short, almost cubical cells with deep brown contents. (Type Herb. Univ. Calif., No. 261174.)

I am designating this *Aglaozonia* with the specific name *pacifica* as a temporary designation until additional collections and farther investigation may demonstrate its true nature and relationships. There can be little doubt that the *Zonaria parvula* var. *duplex* Heydrich (Ber. deutsch bot. Gesell., vol. 10, pp. 473, 474, with fig., 1892) from New Guinea is either the same or more probably closely related to the Tahitian plant. *Zonaria latissima* Kuetz. is probably an erect species with a stupose base and is suspected by J. G. Agardh (Till. Alg. Syst., II, p. 131, 1882) of being the juvenile plant of *Z. Schimperi* Kuetz. It seems, therefore, that it is unlikely to be the same as my species.

~~5057a.~~ On *Porolithon*, over corals, on barrier reef off Papeete, May 26.

APLANOSPOREAE

DICTYOTALES

Dictyota friabilis sp. nov.

Plate 13, figs. 4-7; plate 20, fig. 1

Frondibus tenui-membranaceis, decumbentibus, hinc illinc affixis, friabilibus, atro-brunneis, curtis, usque ad 3 cm. et ultra longis, 3-6 mm. latis, circa 105μ crassis, plus minusve dichotomis, angulis latis rotundatisque, lobis ultimis curtis late obtusis usque ad (in partibus fructiferis) obtuse angustioribus, marginibus leviter undulatis, strato medio, cellulis magnis hyalinis, $75-80\mu$ crassis composito, stratis externis cellulis parvis, circa $12-14\mu$ crassis, coloratis compositis; tetrasporangiis globosis, usque ad 160μ diam., sparsis, irregulariter laxe aggregatis. (Type Herb. Univ. Calif., No. 261252.)

There occurred here and there, always in small quantity, a very puzzling *Dictyota* of which it was difficult to obtain good specimens. The decumbent habit, the frequent attachment by masses of rhizoids, and the friable texture all combined to yield only fragments to the collector. The plants were also largely sterile and the only fruiting portions found differed so much in the shape of the ultimate branches as to still further confuse investigation. There was obtained, however, sufficient data for description and comparison. It seems to be the same as the sterile fragments obtained in Tutuila and listed (cf. Setchell, Veg. Tutuila Island, p. 167, 1924) as *D. lata*?, and this in turn agreed well with a Grunow specimen of this same name (Herb. Missouri Botanical Garden) from Tonga. The tetrasporangia in our specimens are not arranged in lines as described for *D. lata* Lamour. and it is not the *D. robusta* J. Ag., at least as interpreted by Weber-van Bosse (Siboga Exp., Monogr. 59a, p. 184, pl. 3, fig. 3, 1913). In general habit the Tahitian plant approaches that of *D. apiculata* var. *Jedansensis* Weber-van Bosse (Siboga Exp., Monogr. 59a, p. 183, pl. 3, fig. 6, 1913), but lacks the apical mucronate character of the Australian species and of its Makassar variety and is also a thinner plant.

In pools on rocks among other algae. 5014a. Reef at Arue Point, May 19. 5025, 5030c, 5033e. Reef at Tafaa Point, May 19. 5211. Floating, Port Phaeton, June 24 (fruiting).

***Dictyota* (?) *hamifera* sp. nov.**

Plate 14, figs. 1-6

Frondibus epiphyticis supra algas alias repentibus usque ad 3 cm. et ultra longis, 1-2 mm. latis, 80-100 μ crassis, regulariter dichotomis sed ramos hamatos, tumidos, crescentiae definitae in lateribus externis dichotomae plus minusve regulariter gerentibus, laete fuscis, iridescentibus; strato cellularum interno, circa 60 μ sed in ramis hamatis usque ad 300 μ et ultra crassis, stratis externis quibusque circa 10 μ crassis; pilis in caespitibus parvis supra frondes, ramis hamatis exceptis, regulariter sparsis; fructibus ignotis. (Type Herb. Univ. Calif., No. 261356.)

The species here proposed as new has been referred to *Dictyota* although in thickened curved branchlets it resembles *Lobospira*, because, as I interpret it, the branching is not wholly sympodial but dichotomous, with regular production, however, of short curved and swollen branches, lateral in position and of limited growth. These are also borne regularly (or nearly so) on the outside of the dichotomies. The terminal cell of each branch of a young dichotomy divides twice; first unequally, the outer cell (i.e., away from the angle of branching) being left behind by farther growth and becoming the initial cell of the hamate branch. Each of the two branches of the dichotomy after farther growth in length divides again, this time equally, to produce the new dichotomy. In this way the truly dichotomous frond with lateral heteromorphic branches is built up. In *Lobospira* the dichotomies seem of limited growth, giving rise to bicuspidate pinnules and the axes are elongate (sympodial), but no one has, so far as I am aware, given any detailed description of the behavior of the apical cells in this connection, or as to the relation of the cirrhone branchlets to the growth in length or of the lateral axes. It may be necessary later when the fruiting condition has been detected and studied to separate this plant from *Dictyota*.

Overgrowth, forming an iridescent layer over *Laurencia flexilis*. 5125. On reefs between Papenu and Huau, June 5. 5194. On wave benches near Faarapa, June 19.

Dictyota acutiloba J. Ag.?

The specimens of a narrow *Dictyota* referred here are much entangled with other algae but have the habit, acute tips and tetrasporangia in short lines occupying the middle of the frond, characteristic of the Hawaiian *D. acutiloba*. In entangled masses with other algae. 5027. Reef at Tafaa Point, May 19.

Dictyota ciliata J. Ag.

Credited by Grunow (Alg. Novara, p. 49, 1868) to Tahiti.

Padina Commersonii Bory

On reefs and stones. 5014. Reef at Arue Point, May 19. 5024. Reef at Tafaa Point, May 19. 5268. Reef at Punaruu Pass, July 12. 40, Tilden, South Pacific Algae (sub *P. Pavonia*).

I have designated our Tahitian plant by Bory's name following Weber-van Bosse (Siboga Exp., Monogr. 59a, pp. 178, 179, fig. 51, 1913) as to the characters of the species. The Tahiti plants all have naked sori, in more or less interrupted lines just above the lines of hairs and have two layers of cells, one usually smaller than the other. Bory refers a *Padina* collected by D'Urville at Tahiti to his *P. mediterranea* (Dict. Class. d'hist. nat., vol. 12, p. 590, Aug., 1827) and later to his *P. (Pavonia) reniformis* (Voy. Coquille, Bot. (Crypt.), p. 146).

Grunow (Alg. Novara, p. 50, 1868) lists *Padina Pavonia* from Tahiti and later (Jour. Mus. Godeffroy, Heft VI, p. 25, 1873, 1874) determines a specimen from Tahiti (collected by Ida Pfeiffer) as "*P. Fraseri* Grev.," citing, however, Kuetzing's figure of *Zonaria Fraseri* (Tab. Phyc., vol. 6, pl. 73, 1). According to Weber-van Bosse, the Kuetzing plant is *P. Commersonii* (Siboga Exp., Monogr. 59a, p. 179, 1913).

Zonaria variegata (Lamour.) Ag.?

Prostrate, entire or laciniately deeply lobed, thin, sterile plants, clearly of this genus and of the relationship of this species. The structure agrees with that of *Z. variegata*. 5239. Reef at Tahara Mountain, July 9.

CYCLOSPOREAE

FUCALES

***Durvillea utilis* Bory**

This is a fourth species characteristic of the western coast of South America and New Zealand, which Grunow (*Alg. Novara*, p. 51, 1868) has credited to the coast of Tahiti. From my own experience, I feel convinced that none of these four (*Macrocystis*, the two species of *Lessonia*, and *Durvillea*) grows there and that even chances of their being cast ashore are slight.

***Turbinaria ornata* (Turner) J. Ag.**

On exposed reefs, often forming a belt, either pure or mixed with *Sargassum* or *Chnoospora*. 5001, 5003a. Reef at Arue Point, May 19. 5030a, 5033k. Reef at Tafaa Point, May 19. 5053. Barrier reef opposite Papeete, May 26. Montagne (*Voy. au Pol. Sud., Bot.*, pl. cell., p. 75, 1845) credits *T. decurrens* Bory to Tahiti.

***Sargassum boraboreense* (Grunow) comb. nov.**

Plate 15, fig. 5

S. obtusifolium var. ? *boraboreense* Grunow, *Verh. K. K. zool.-bot. Gesell. Wien*, vol. 66, p. 30, 1916.

While Grunow's variety was published by him in that form, yet he practically indicates his opinion that it may very likely be entitled to specific rank. It differs decidedly in aspect from typical *S. obtusifolium* from Hawaii and approaches more nearly *S. vulgare* var. *foliosissima*. The inflorescence, however, is more nearly that of the "*Fruticulosae*," although the individual receptacles are short (about 1 mm. in length) and crowded. The leaves vary (in the specimens I refer here) from undulate to remotely dentate, are broader than in typical *S. obtusifolium*, and while longer than Grunow's description calls for (in my specimens up to 2.5–3 cm. long), are also broader even than those of the Grunow type and decidedly broader than those of typical *S. obtusifolium* as found on the reefs of Tahiti. *S. boraboreense* occupies, in common with the three other species enumerated in this

account, a narrow belt, parallel to the wave front, exposed to full wave action at times of high water, and just within the broad marginal *Porolithon* belt. It seems best, at least for the present, to take a narrow view of species in the genus *Sargassum*, but it may be mentioned here that a broad view might include all four of the species as I have outlined them and also in accordance with certain indications on the part of Grunow as to his own opinion, under a major species and this major species is probably *S. obtusifolium* unless *S. vulgare* is to be considered as generally inclusive of the Pacific as well as Atlantic forms and of extremely broad content. In such case the three tribes of the *Malacocarpicae*, viz., the *Fruticulosae*, *Cymosae*, and *Racemosae*, must necessarily be combined and the practical difficulties now encountered of distinguishing between these three overlapping tribes would be eliminated. It does not seem desirable to do this, but rather to attempt the somewhat finer distinctions already in force and to carry these out to their legitimate conclusions. *Sargassum boraborensense*, then, is to be distinguished from the other Tahitian species by its lack of vesicles, its extremely short conceptacles arranged in a compact "fruticulose" inflorescence, and its fairly short, broad, undulate or remotely coarsely toothed leaves. Grunow's type is from the Island of Borabora but he also credits it to Tahiti.

On basaltic rocks, forming a belt exposed to the surge. 5124. Shore between Papenu and Huau, June 5.

***Sargassum sociale* (Grunow) comb. nov.**

Plate 15, figs. 3, 4

S. vulgare var.? *socialis* Grunow, Verh. K. K. zool.-bot., Gesell. Wien, vol. 66, p. 44, 1916.

In accordance with the ideas expressed in the consideration of the preceding species, I am following out the implied suggestion of Grunow, in separating this Tahitian plant from the varieties clustering about *Sargassum vulgare*. In doing this, I am aware that my action implies the suggestion that the same treatment be applied to other varieties and forms now included under the species. While no type of *S. vulgare* is designated, it seems practicable to consider the plant figured by Turner (Fuci, pl. 46) as typical. This appears to be *Eusargassum* of the *Malacocarpicae* series and the tribe *Cymosae*, with filiform multifarious branchlets, having distinct spherical vesicles on narrow flattened petioles and toothed costate leaves with conspicuous

cryptostomata. The leaves are rather narrow and fairly long. Beyond this general description, it becomes a matter of smaller detail and dimensions.

The plants I am referring to *S. sociale* do not entirely agree in detail with Grunow's description, especially in not having uniformly mucicous or apiculate vesicles, although such vesicles do occur here and there among the specimens. They do have branches of the proper length (up to 8 cm.), leaves of the proper length (about 1 cm. above and 3-4 cm. below), acute or obtuse, sharply toothed, and with conspicuous cryptostomata in a double row on each side of the strong costa. The vesicles correspond and the pedicel is usually longer than the vesicle, strongly flattened, frequently broadly foliaceous, toothed and with cryptostomata. The receptacles are about 4 mm. long and distinctly cymose. Grunow's type is from Tahiti.

Forming a broad belt in full surge. 5052. Barrier reef opposite Papeete, May 26. 5248. Reef at Punaruu Pass, July 11. 5000. Reef at Arue Point, May 19 (with *S. tahitense*).

***Sargassum mangarevense* (Grun.) comb. nov.**

Plate 15, fig. 6; plate 16, figs. 1-5

S. vulgare var. ? *mangarevensis* Grunow, Verh. K. K. zool. bot., Gesell. Wien, vol. 66, p. 44, 1916.

The type of Grunow's variety is from the Island of Mangareva in the archipelago to the eastward of Tahiti. For the same reason as given under the two preceding species, it seems best to take the narrower viewpoint and consider this a species. In characters it resembles the last, but the ramuli are short, the leaves are slightly shorter and in ours less sharply and much more remotely dentate, the stalk of the vesicle is narrow, never foliose in our plant, and the receptacles are somewhat longer. The latter character seems distinctive.

Forming a belt just within the outer edge of exposed reefs. 5153. In "pot-holes" on reef at Tahara Mountain, June 17. 5156. Belt on reef at Tahara Mountain, June 17. 5223. Reef at Arue Point, June 27. 5260. Reef at Punaruu Pass, July 11.

***Sargassum tahitense* Grunow**

The plants referred to this species are fairly distinctly set off from the rest of our Tahitian collections by their distinctly racemose inflorescences. In this they resemble *S. Henslowianum* Ag. and *S. paniculatum* J. Ag. *S. tahitense* lacks vesicles and has very much shorter (about 8 mm. high) racemes of receptacles. Grunow named this *S. cheirifolium* var. *tahitense* (Jour. Mus. Godeffroy, Ileft VI, p. 28, 1873-1874) but later (Verh. K. K. zool.-bot., Gesell. Wien., vol. 66, p. 177, 1916) raised it to specific rank.

Forming, in connection with *S. sociale*, a broad belt, exposed to full surge. 5000a. Reef at Arue Point, May 19.

Sargassum obtusifolium is credited to Tahiti by Grunow (Alg. Novara, p. 57, 1868). There are several other species of *Sargassum* accredited to Tahiti but doubtful as to correct locality.

S. biserrula f. *pacifica* (Bory) Grun. (*S. pacificum* Bory, Voy. Coquille, Bot., Crypt., p. 123, 1828). "Otaiti." Grunow (Verh. K. K. zool.-bot., Gesell. Wien, vol. 65, p. 416, 1915) states that he has seen an authentic specimen. He places it among the *Acanthocarpicae*, of which I have seen no member at Tahiti.

S. gracile var. *pseudogranulifera* Grunow, floating on the ocean somewhere between Tahiti and New Zealand.

S. bacciferum f. *Chamissonis* Grunow. Tahiti (*fide* Grunow), probably floating.

S. bacciferum f. *latiuscula* Grunow. Tahiti (*fide* Grunow), probably floating.

RHODOPHYCEAE

NEMALIONALES

Acrochaetium sp. nov. aff. **A. Hoytii** Collins?

On 5108. Reefs between Papenu and Huau, June 5. Arising from a single rounded cell, epiphytic on *Cladophora*.

Galaxaura rudis Kjellm.

A single specimen cast ashore. 5269. Punaruu Pass, July 12. This seems to agree with Kjellmann's type material from Tonga.

Galaxaura glabriuscula Kjellm.

In frequent dull red patches. 5005. Reef at Arue Point, May 19. The type is from Tahiti.

Actinotrichia rigida (Lamour.) Dec'ne.

Frequent on all reefs. 5006. Reef at Arue Point, May 19. 5028, 5033 π . Reef at Tafaa Point, May 19. 5078. Barrier reef opposite Papeete, May 30. 5100. Reefs between Papenu and Huau, June 5. Grunow (Jour. Mus. Godeffroy, Heft VI, p. 39, 1873-1874) credits this species to Tahiti.

Gelidium rigidum (Vahl) Grev.

In coarse entangled masses mixed with other algae. 5007, 5011. Reef at Arue Point, May 19. Typical forms of this species and the usual variants occur frequently on the reefs about Tahiti. Grunow (Alg. Novara, p. 81, 1868) also reports it from Tahiti.

Gelidium intricatum (Ag.) Kuetz.

The types of this species came from the Indo-Pacific region and Grunow has determined specimens collected in Tahiti as belonging to it (Herb. Univ. Calif., et al.). I have already detected it in Samoa (cf. Setchell, Veg. Tutuila Is., p. 163, 1924) and it was collected by

the U. S. Exploring Expedition under Wilkes in the "Pacific Islands." It is much coarser, much more rigid, more entangled, and more inclined towards a greenish color than *G. delicatulum*. Cartilaginous, wiry, and entangled with other algae, usually in extended or interrupted turf-like patches. 5029, 5033c. Reef at Tafaa Point, May 19.

***Gelidium delicatulum* (Kuetz.) Setchell**

Slender, neither crisped nor much entangled; in tufts. 5109b. On rocks, mixed with other algae, reefs between Papenu and Huau, June 5.

***Gelidium samoense* Reinbold**

Plate 17, figs. 1-6

Reinbold compares his species to Kuetzing's *Acrocarpus pulvinatus* and also to his *Sphaerococcus angustifolius*. Our plant bears some resemblance to the former but the latter is more closely resembling the plant we have referred to *G. acrocarpum* Harv. In the Tahitian collections I find a form clearly answering to Reinbold's description and this form I have represented on plate 17, figures 1 and 2. I find also, most intimately intermixed, a narrow flattened form, or possibly distinct species, represented on plate 17, figures 3 to 6. I am keeping the two forms together for the present but suspect that two species may be represented. I am designating the narrow form as f. *lineare*.

Forming a dark red turf. 5109a. Reefs between Papenu and Huau, June 5.

***Gelidium acrocarpum* Harv.**

Plate 18, figs. 1, 2

In small tufts among other algae, usually shaded under *Sargassum*. 5184. Reef at Tahara Mountain, June 18. 5192. On wave benches at Faarapa, June 19.

I have noted above that there is a strong resemblance between the plants referred to this species and those illustrated by Kuetzing under *Sphaerococcus angustifolium* from New Caledonia (Tab. Phyc., vol. 18, pl. 99, c-i, 1868).

GIGARTINALES

Iridaea micans Bory

This Chilean species is credited to Tahiti by Grunow (Alg. Novara, p. 69, 1868). If properly determined, it may be that there has been in this case, as in the cases of the two Lessoniae, Macrocystis, and Durvillea, a transposition of labels as to locality of collection.

RHODYMENIALES

Hypnea nidifica J. Ag.

Plate 18, figs. 3-7

This species seems to be the *Hypnea divaricata* Kuetz. (Tab. Phyc., vol. 18, pl. 25, *d-g*, 1868) but not the *Fucus divaricatus* R. Br. (in Turner, Fuci, vol. 3, pl. 181, 1811) which may be the *Hypnea divaricata* Grev., if it is a true *Hypnea*, concerning which J. G. Agardh states otherwise. *Hypnea Esperii* Kuetzing (Tab. Phyc., vol. 18, pl. 26, figs. *a-c*, 1868) represents well a variant of the Tahiti plant, but is probably not the *H. Esperii* Bory (Voy. Coq., Bot., Crypt., p. 157, 1829) judging from its lack of agreement with Esper's figures cited by Bory as illustrative of his species. J. G. Agardh's *Hypnea divaricata* seems more nearly related to *H. Valentiae*, to which the figure of Turner bears a considerable resemblance. I have attempted to show (pl. 18, figs. 3-5) something of the variety of detail in the branching of the Tahiti plants I refer to this species, which agree well with specimens from Hawaii, the type locality of *Hypnea nidifica* J. Ag.

Forming bright red bristly tufts on tips of the coarser algae. 5193. Wave benches near Faarapa, June 19.

Hypnea nidulans Setchell

In flattened masses, nestling into crevices. 5158. Reef at Tahara Mountain, June 17. 5186. Reef at Tahara Mountain, June 18. This is identical in characters and habit with the Samoan plant.

Hypnea spinella J. Ag.

Grunow credits this species to Tahiti (Alg. Novara, p. 80, 1868). The type is from the West Indies and is said to be closely related to *H. pannosa* J. Ag., the type of which is from the tropical Pacific Coast of Mexico. I suspect that Grunow's plant may belong to the preceding species, which has, when growing compactly, a superficial resemblance to *H. pannosa*.

Asparagopsis Sanfordiana Harv.

Floating in lagoon moat. 5280. Near Outo-maoro, July 15. The filaments are thickly infested with *Lyngbya epiphytica* Hieron.

Laurencia flexilis sp. nov.

Plate 19, figs. 1-6

Frondibus teretibus erectis, e surculis prostratis repentibusque assurgentibus, infero nudis aut ramis curtis irregularibusque vestitis, supero quoqueversum alterne ramosis, ramis comparate brevibus, ramulos brevissimos plerumque ordine singulo ferentibus alternis aut raro oppositis; ramis primariis basi attenuatis, apice plerumque leviter tumidis; ramulis plus minusve angustis aut turbinatis; antheridiis glomerato-paniculatis, glomerulo quoque cellulo tumido pyriformi apiculato; tetrasporangiis in apices tumidas ramulorum immersis; cystocarpiis ignotis; planta gregaria, atrorubra, usque ad 8 cm. alta, 2-3 mm. crassa, flexilis, cartilaginea. (Type Herb. Univ. Calif., No. 261333.)

The only *Laurencia* we found in Tahiti was fairly frequently met with, gregarious, wiry, with branches above, but scant and never opposite. It resembles *L. obtusa* and *L. obtusiuscula* but has branches only of two or rarely of three orders and the ultimate short branchlets broadly turbinate.

In patches, usually overgrown with other more finely filamentous algae. 5003, 5051b. Reef at Arue Point, May 19. 5104a, 5115. Reefs between Papenu and Huau, June 5. 5190. Wave benches at Faarapa, June 19. 5246. Forming a broad belt just within the *Turbinaria* belt on reef at Tahara Mountain, July 9.

***Cladhymenia pacifica* sp. nov.**

Plate 22, figs. 3, 4

Frondibus rubescentibus complanato membranaceis e surculis complanatis sed crassis, sparse pinnato ramosis, repentibus assurgentibus, infero complanato-cylindricis, late cuneatis, supero latis, dichotome pinnate divisio laciniatisque, usque ad 3-3.5 cm. altis, divisionibus primariis 2-3 mm. latis, segmentis ultimis lobatis; tetrasporangiis tripartitis in lobulis ultimis immersis; cystocarpiis ignotis. (Type Herb. Univ. Calif., No. 261336.)

The new species proposed above has also been seen among my collections from the Hawaiian Islands. It seems to belong to the genus *Cladhymenia*, although I cannot satisfactorily trace an axial row of cells or pericentral cells even at the tip. It bears some resemblance to the very complanate species of *Laurencia* but the flattened frond seems divided and lobed rather than properly branched. The flattened rhizome, bearing stalked fronds, recalls both *Cladhymenia* and *Rodriquezella* but the likeness is rather with the former than with the latter.

In small clusters of dark red fronds. 5220. Among algae, *Sargassum* belt, reef at Arue Point, June 27.

***Murrayella squarrosa* (Harv.) Schmitz**

In dark red, ample tufts on stones near high water mark. 5088. Near Maara, Papeari District, June 2. Although sterile, our plants seem to belong to this Tongan species. They agree with No. 21 of Harvey's Friendly Islands Algae.

***Polysiphonia tongatensis* Harv.**

In loose spreading masses in shallow water, with *Cladophora rhadina*. 5213. Port Phaeton, June 24. Our specimens agree well with Kuetzing's description and figure of Harvey's Tonga plant (Tab. Phyc., vol. 14, pl. 41, figs. a-d, 1864) but not with his figure of *P. mollis* Hook. and Harv. (Tab. Phyc., vol. 13, pl. 88, figs. a-c, 1863) nor with the original description of *P. mollis* (Nereis Australis, p. 43, 1847), whence it appears that *P. mollis* arises from a discoid holdfast, and resembles *P. variegata*, but is even coarser (De Toni, Syll. Alg., vol. 4, p. 877, 1903) and more fibrillose. *P. tongatensis* resembles most closely *P. Olneyi* Harv. and *P. subtilissima* Mont., both species of the Atlantic American coasts. *P. subtilissima* is indicated (Kuetzing,

Tab. Phyc., vol. 13, pl. 28, figs. *a-e*, 1863) as being destitute of "leaves" and the branching, therefore, is not axillary. *P. tongatensis*, on the other hand, has "leaves" and axillary branching (Kuetzing, *loc. cit.*, vol. 14, pl. 41, figs. *a-d*). *P. Olneyi* has a creeping base, as is the case in *P. tongatensis*, but has no "leaves" (Harvey, *Ner. Bor.-Amer.*, pt. 3, pl. 17, *B*, 1858).

***Herposiphonia parca* sp. nov.**

Plate 20, fig. 2

Filamentis solitariis aut paucissime aggregatis, repentibus, epiphyticis, dilute brunneis usque ad 2 mm. longis (et ultra?), 0.14–0.16 mm. latis, ramosis ramulosisque, per ramulos rhizoideos bicellulares apice discoideos crenellatosque aut brevi- aut fastigiato-ramellosis, ad algas alias (*Dictyosphaeriam australem*) affixis; ramis et curtis et longioribus in seriebus duabus in dorso filamentorum primariorum ordinatis; ramis curtis oblongo-cylindricis, 5–7-articulatis, usque ad 0.5 mm. altis et 0.14 mm. latis, apice obtuse-rotundatis, basi abrupte contractis, juvenis pilo singulo curtoque, mox deciduo, ornatis; ramis longioribus, alternatim cum ramis curtis in geniculum quodque quartum positis, filamento primario similibus et, cum iis, ramulos et apicem involutam piliferamque ferentibus; cellulis pericentralibus 10; tetrasporangiis cystocarpiisque ignotis. (Type Herb. Univ. Calif., No. 261147.)

5224*b*. Crawling over *Dictyosphaeria australis*, forming scattered minute spots, Arue Reef, June 27.

The material upon which this species is founded, while scanty and sterile, seems characteristic. The low, blunt, comparatively stout branches of the short series, neither attenuated nor curved at the tips, as well as its dwarf (or dwarfed?) habit, distinguish the species from any of the group with 10-pericentral cells.

***Lophosiphonia sparsa* sp. nov.**

Plate 21, figs. 3, 4

Filamentis atro-fuscis, omnibus repentibus, omnino ecorticatis, aut ramis erectis subinde declinatis in superficie *Dictyosphaeriae australis* epiphyticis, solitariis aut paucè-aggregatis, usque ad 5–6 mm. longis et 0.3 mm. latis, articulis propter duplo brevioribus quam latis, apicibus lente incurvatis et pilis simplicibus, curtis, et deciduis, ornatis, ramis fere equalibus, alternis aut secundatis primo erectis, subinde prostratis, omnibus per ramulos, unicellulares apice discoideo-crenellatos ad algas affixis; tetrasporangiis, in stichidiis ramosis, apicalibus, parum transformatis, situatis, spiraliter uno in articulo quoque ordinatis; cystocarpiis ignotis. (Type Herb. Univ. Calif., No. 261144.)

5224c. In small dark brown patches on *Dictyosphaeria australis*, intermingled with *Bostrychia exigua*, Arue Reef, June 27.

Of the three Rhodomelaceae epiphytic on *Dictyosphaeria australis*, this is the most abundant. I refer it to *Lophosiphonia* with some doubt as it seems to agree neither with *Polysiphonia* nor with *Herposiphonia*, but since it is a prostrate species with slight dorsiventrality and without any definite differentiation between long and short branches, I am inclined to place it in *Lophosiphonia*. It does not agree with any of the species of the genus with 4-pericentral cells. It seems to come nearest to *L. prostrata* (Harv.) Falkenb. with its short pericentral cells, but that species is much taller and seems to have more strongly marked differences between the two forms of branches.

***Bostrychia (Stictosiphonia) exigua* sp. nov.**

Plate 21, figs. 1, 2

Filamentis cylindricis, gracillimis, cum algis aliis intertextis, caespitos exiguos millemetris paucis diam. formantibus, colori ignoto sed pallescentibus, epiphyticis; fronde tota ecorticata, usque ad 5 mm. et ultra (?) longa et 0.1 mm. lata, irregulariter ramosa, ramis rare ramulosis, nunc singulis nunc oppositis aut paucis-fasciculatis, flexilibus, supero longe attenuatis et late arcuatis, apice neque distincte neque abrupte revolutis; cellulis pericentralibus usque ad 9, supero parum paucioribus quibusque transverse 6-divisis, cellulis ultimis 3-4, nudis et indivisis; tetrasporangiis in medio tertio ramulorum longorum parum sed non abrupte tumidorum situatis, 1-3-verticillatis; cystocarpiis ignotis. (Type Herb. Univ. Calif., No. 261059.)

In minute patches, intermingled with *Lophosiphonia sparsa* on *Dictyosphaeria australis*. 5224d. Arue Reef, June 27.

This species seems to be the most lowly, most slender, and the least abundantly branched species of the *Stictosiphonia* group. It probably comes closest to *B. fastigiata* Harvey, but is of somewhat different habit and seemingly much more slender. The stichidia are barely differentiated, much less so than in any other closely related species.

CERAMIALES

Centroceras clavulatum (Ag.) Mont.

Forming red tufts or expanded turf-like patches. 5033*h*. Reef at Tafaa Point, May 19. 5118. On basaltic rocks between Papenu and Huau, June 5. 5265. Reef at Punaruu Pass, July 11. Montagne (Voy. au Pol. Sud., Bot., Pl. Cell., p. 93, 1845) has credited this species to Tahiti (sub *Spyridia clavulata*).

Ceramothamnion Codii Richards?

Plate 22, fig. 2

Creeping among the utricles of various species of *Codium*. Noted particularly under the number given below. J. Reef at Punaruu Pass, July (with tetrasporangia).

Crouania attenuata (Bonnem.) J. Ag.

A slender form of this species is credited to Tahiti by Grunow (Alg. Novara, p. 62, 1868).

DUMONTIALES

Chondrococcus Harveyi (J. Ag.) De Toni

In small tufts exposed to currents. 5157. Reef at Tahara Mountain, June 17. 5183. Reef at Tahara Mountain, June 18 (with cystocarps). 5191. On wave benches at Faarapa, June 19.

Peyssonnelia rubra (Grev.) J. Ag.

Forming bright red, mostly thin disk-shaped and loosely attached, brittle, but only slightly calcified crusts. 5033*e*, 5042*a*. Reef at Tafaa Point, May 19. 5170*a*, 5170*d*. Wave bench at Tahara Mountain, June 17 (with tetrasporangia).

Peyssonnelia conchicola Picc. et Grun.

5057*a*. Barrier reef opposite Papeete, May 26.

***Peyssonnelia calcea* Heydr.**

5059. Barrier reef opposite Papeete, May 26. 5200a. Faarapa Reef, June 19. 5273. Reef at Punaruu Pass, July 12.

***Cruoriopsis Reinboldii* Weber-van Bosse?**

5261. Reef at Punaruu Pass, July 11.

***Cruoriella nitida* Weber-van Bosse?**

5021a. Arue Reef, May 19 (with tetrasporangia).

***Cruoriella intermedia* Weber-van Bosse**

5065. Reef at Pipini, District of Arue, May 24 (with tetrasporangia). 5176. Wave bench, Tahara Mountain, June 17. 5234b. Reef at Arue, June 27.

***Cruoriella dura* (Heydr.) Weber-van Bosse**

5021. Arue Reef, May 19 (with tetrasporangia). 5033d. Reef at Tafaa Point, May 19. 5128. Reefs between Papenu and Huau, June 5. 5170. Wave bench at Tahara Mountain, June 17.

***Amphiroa fragilissima* (L.) Lamour.**

Forming turf-like expansions on reef. 5032, Tafaa Point, May 19.

Our specimens seem to be of the typical form (cf. Weber-van Bosse, Siboga Exp., Monogr. 59a, p. 91, 1904).

***Cheilosporum jungermannioides* Rupr.**

In tufts in shallow pools, on all the reefs. 5056, 5066. Barrier reef opposite Papeete, May 26. 5168, 5169. Reef at Tahara Mountain, June 17. 5016. Reef at Arue Point, May 19.

Tahiti is the type locality of this species. Weber-van Bosse has reported it from the south coast of Java and I have collected it on the reefs of Tutuila Island in the Samoan Group.

***Jania adhaerens* Lamour. ff.**

In tufts and scattered thickly over other algae. 5117. On rocks, reefs between Papenu and Huau, June 5. 5245. On *Laurencia*, in pool, outer edge of reef at Punaruu Pass, July 11.

I have assigned the two sets of specimens cited above to this species on the strength of Kuetzing's figures *d* and *e* on plate 83, volume 8, of the *Tabulae Phycologicae*. These plants grew in tufts, are relatively long and slender, with branches of the dichotomies strict, and terminal cells sharply conical. I have specimens scattered through the collection having short squarrose plants of the type of figures *f* and *g* of Kuetzing. It is to be understood that the determinations are tentative.

***Jania corniculata* (L.) Lamour var.?**

This curious plant seems to agree in general with Harvey's figure (*Phyc. Brit.*, vol. 2, pl. 234) and even better with that of Kuetzing (*Tab. Phyc.*, vol. 8, pl. 9, fig. II, 1858), but may differ from the European plant in some details. The branching is dichotomous in general but is pinnate at times, especially above. The joints are flattened and long cornute at the upper angles, with the horns unjointed. The young cystocarps are of the young *Janioid* type and the plant may be only a variety of *J. rubens* L. In tufts, in pools exposed to surge. 5244. Reef at Punaruu Pass, July 11.

***Archaeolithothamnium erythraeum* (Roth) Foslie**

5189. Reef at Tahara Mountain, June 18. 5207. Papeivi Pass, June 24. 5228. Arue Reef, June 27 (with sori).

***Lithothamnium tahiticum* Foslie**

The type (Foslie, Kgl. Norske Vidensk. Selsk. Skrifter, 1906, No. 8, p. 8, 1907, sub *Lithothamnion japonicum* f. *tahitica* Foslie) is said to have come from "Tahiti; Tearia" a locality unknown to me, but which I suspect may be an atoll locality in the Tuamotu Archipelago.

***Lithothamnium siamense* Foslie?**

5033c. Reef at Tafaa Point, May 19. 5288. Arue Reef, June 27.

***Lithothamnium simulans* Foslie?**

5128. Reefs between Papenu and Huau, June 5.

***Lithothamnium fragilissimum* Foslie**

5022. Arue Reef, May 19. 5187. Reef at Tahara Mountain, June 18. 5232. Arue Reef, June 27.

Lithothamnion Dickiei Foslie

This species was collected by the Challenger Expedition and listed by Dickie (Proc. Linn. Soc., vol. 15, p. 486, 1877) as *L. imbricatum* and given as occurring in 20 fathoms at Papeete Harbor off Tahiti. Foslie (The Lithothamnina of the Maldives and Laccadives, pp. 460, 461, 1903) says that "The Challenger Expedition met with a bank off Tahiti, which had probably been formed by a single species, *Lithothamnion Dickiei*."

Lithothamnium thelostegium Foslie?

5020. Arue Reef, May 19. The type locality is given as "Rikitea, Tahiti." Rikitea is on Mangareva of the Gambier Group of the Tuamotu Archipelago.

Choreonema sp.?

Parasitic on *Jania adhaerens* Lamour. 5245. Reef at Punaruu Pass, July 11.

There were found on *Jania adhaerens* a few young conceptacles of a species of *Choreonema*, too immature to determine whether cystocarpic, antheridial, or tetrasporic, but probably the first. It seems likely that they may belong to an undescribed species, since they are only a little over 90 μ in diameter and somewhat less than that in height. The central portion appears to have carpogonia, but I cannot make them out clearly. The material is too scanty for record of other than as to the genus.

Fosliella farinosa (Lamour.) Howe

Forming a thin whitish to light rose colored layer (usually of confluent thalli) on larger algae. 5000a. Arue Reef, May 19. 5024. Reef at Tafaa Point, May 19. 5223. Arue Reef, June 27. 5053. Reef at Punaruu Pass, July 11. (Tetrasporangia common!)

Litholepis accola Foslie

5042b. Reef at Tafaa Point, May 19. The type locality is given as "Hao, Tahiti." Hao is an atoll of the Tuamotu or Low Islands. What seems to be this has been found in sterile form in a number of my preparations.

Lithoporella melobesioides Foslie

5057*b*. Barrier reef opposite Papeete, May 26.

Mastophora macrocarpa var. **condensata** Foslie

5163, 5177. Wave bench at Tahara Mountain, June 17 (with tetrasporangia).

Lithophyllum sp. nov.?

5063. Reef at Pipini, Arue District, May 24. (Herb. Univ. Calif., No. 261196.)

Lithophyllum samoense Foslie

5201. Reef at Faarapa, Papenu District, June 19. This is also credited to Tahiti by Foslie (Kgl. Norske Vidensk. Selsk. Skrifter, 1906, No. 2, p. 20, 1906).

Lithophyllum Kaiserii (Heydr.) Heydr.

5015. Arue Reef, May 19. 5034. Reef at Tafaa Point, May 19. 5060. Barrier reef opposite Papeete, May 26. 5178. Wave bench at Tahara Mountain, June 17. 5233. Arue Reef, June 27. 5284. Reef at Tahara Mountain, July 15. (Usually with tetrasporangia!)

Dermatolithon rasile (Foslie) Foslie

The type of this species (Foslie, Kgl. Norske Vidensk. Selsk. Skrifter, 1906, No. 8, p. 34, 1907, sub *Lithophyllum* (*Dermatolithon*) *rasile* Foslie) is said to have come from Tahiti. I suspect that the type locality may have been Mangareva or some other member of the Tuamotu Archipelago.

Goniolithon myriocarpon Foslie

5075. Barrier reef opposite Papeete, May 30. 5175. Wave bench at Tahara Mountain, June 17. 5231*a*. Arue Reef, June 27. 5283. Reef at Tahara Mountain, July 15. 5285. Reef at Tahara Mountain, July 15. This is credited (f. *confragosa* Foslie) to Tahiti by Foslie (Kgl. Norske Vidensk. Selsk. Skrifter, 1906, No. 8, p. 14, 1907).

Goniolithon Fosliei (Heydr.) Foslie

5227. Arue Reef, June 27. 5230. Arue Reef, June 27.

Goniolithon megalocystum Foslie

5019. Arue Reef, May 19. 5061. Barrier reef opposite Papeete, May 26.

Goniolithon Reinboldii (Foslie) Foslie

5026. Reef at Tafaa Point, May 19. 5208. Papeivi Pass, Papeari District, June 24.

Goniolithon Harioti Foslie

This is credited to "Mangareva, Tahiti," but Mangareva is a "high" island of the Gambier Group of the Tuamotu Archipelago (cf. Foslie, Kgl. Norske Vidensk. Selsk. Skrifter, 1906, No. 8, p. 13, 1907). I have not recognized it among our collections, but may have confused it with *G. megalocystum* Foslie.

Porolithon onkodes (Heydr.) Foslie

5047a. Arue Reef, May 23. 5057. Barrier reef opposite Papeete, May 26. 5064. Reef at Pipini, Arue District, May 24. 5076. Barrier reef opposite Papeete, May 30. 5225. Arue Reef, June 27. 5231. Arue Reef, June 27. 5262. Reef at Punaruu Pass, July 11. 5264. Reef at Punaruu Pass, July 11.

Porolithon craspedium (Foslie) Foslie

Lemoine (Struct. Anat. Melobes., p. 165, 1911) credits this species to "Tahiti (Makaroa)," a locality unknown to me, but I suspect that there may be confusion with Takaroa (Tiakea), an atoll of the Tuamotu Archipelago, since all other records of this species are to atolls.

EXPLANATION OF PLATES

**All drawings on plates 7-22 were made by Miss Anna Hamilton
under the direction of W. A. Setchell.**

PLATE 7

Ulva Lactuca f. *lacinulata* (Kuetz.) Hauck

- Fig. 1. Habit of plant (No. 5107) on *Laurencia flexilis* Setchell. Nat. size.
Fig. 2. Transverse section of frond towards the center (No. 5107). $\times 325$ diam.
Fig. 3. Similar section nearer the margin (No. 5107). $\times 325$ diam.
Fig. 4. Surface view of margin (No. 5107). $\times 325$ diam.

Boodlea karneana Brand.

- Fig. 5. Portion of filament (No. 5214) to show branches, segments, and tenacula, but not showing anastomoses. $\times 12.5$ diam.



PLATE 8

Cladophoropsis herpestica (Mont.) M. A. Howe

Figs. 1-3. Isolated filaments (No. A). $\times 4$ diam.

Chaetomorpha basiretrorsa Setchell

Figs. 4-6. Bases of filaments (No. 5271). $\times 10$ diam.

Chaetomorpha fibrosa Kuetz.?

Figs. 7, 8. Ends of filaments (bases (?) not attached) (No. 5160) $\times 2$ diam.

Dictyosphaeria australis Setchell

Fig. 9. Side view of a smaller plant (No. 5224). $\times 2$ diam.

Fig. 10. Vertical section through the same plant. $\times 2$ diam.

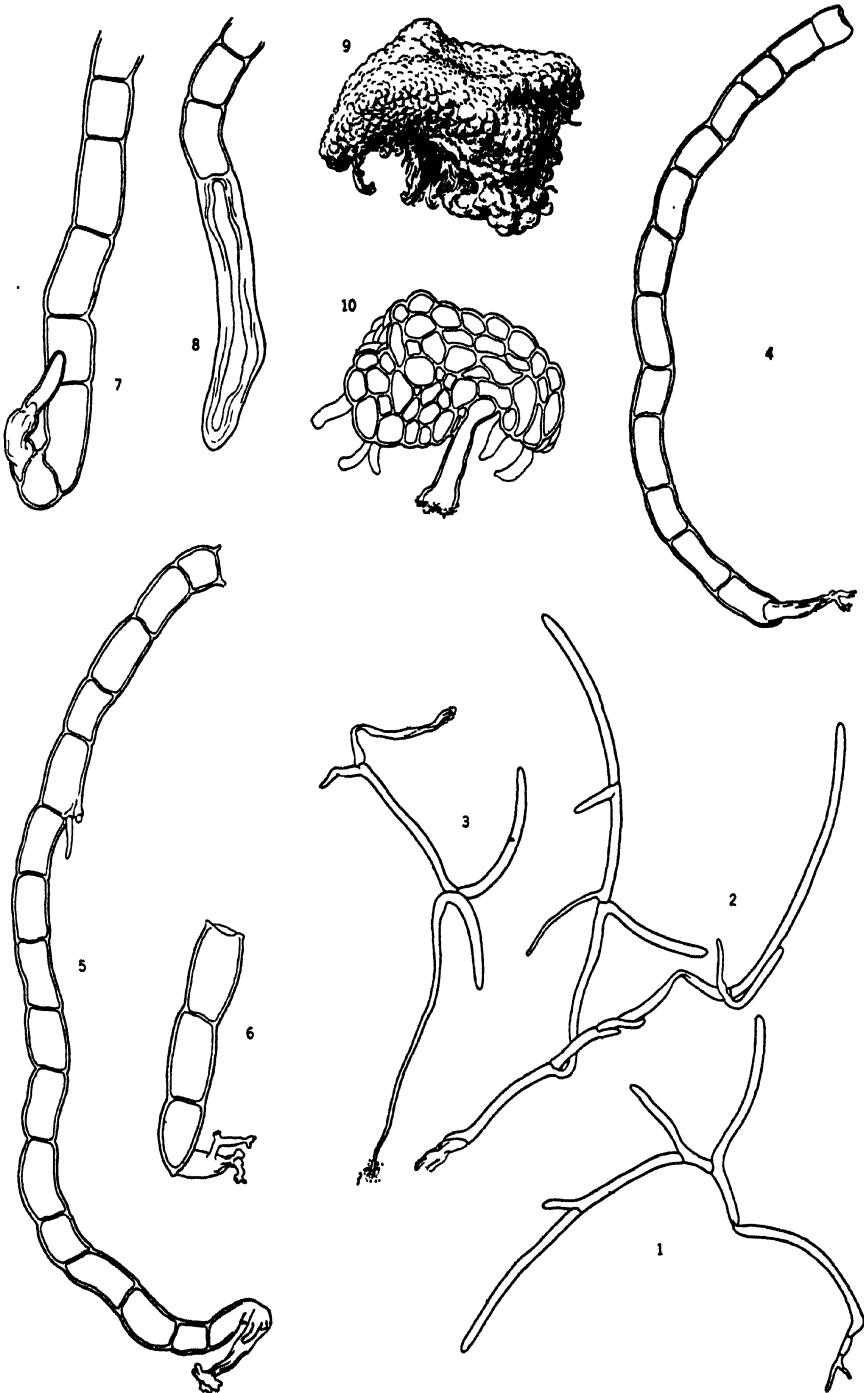


PLATE 9

Cladophora patentiramea (Mont.) Kuetz.

Portion of plant spread out to show details of branching, etc.
(No. 5138). $\times 1.25$ diam.

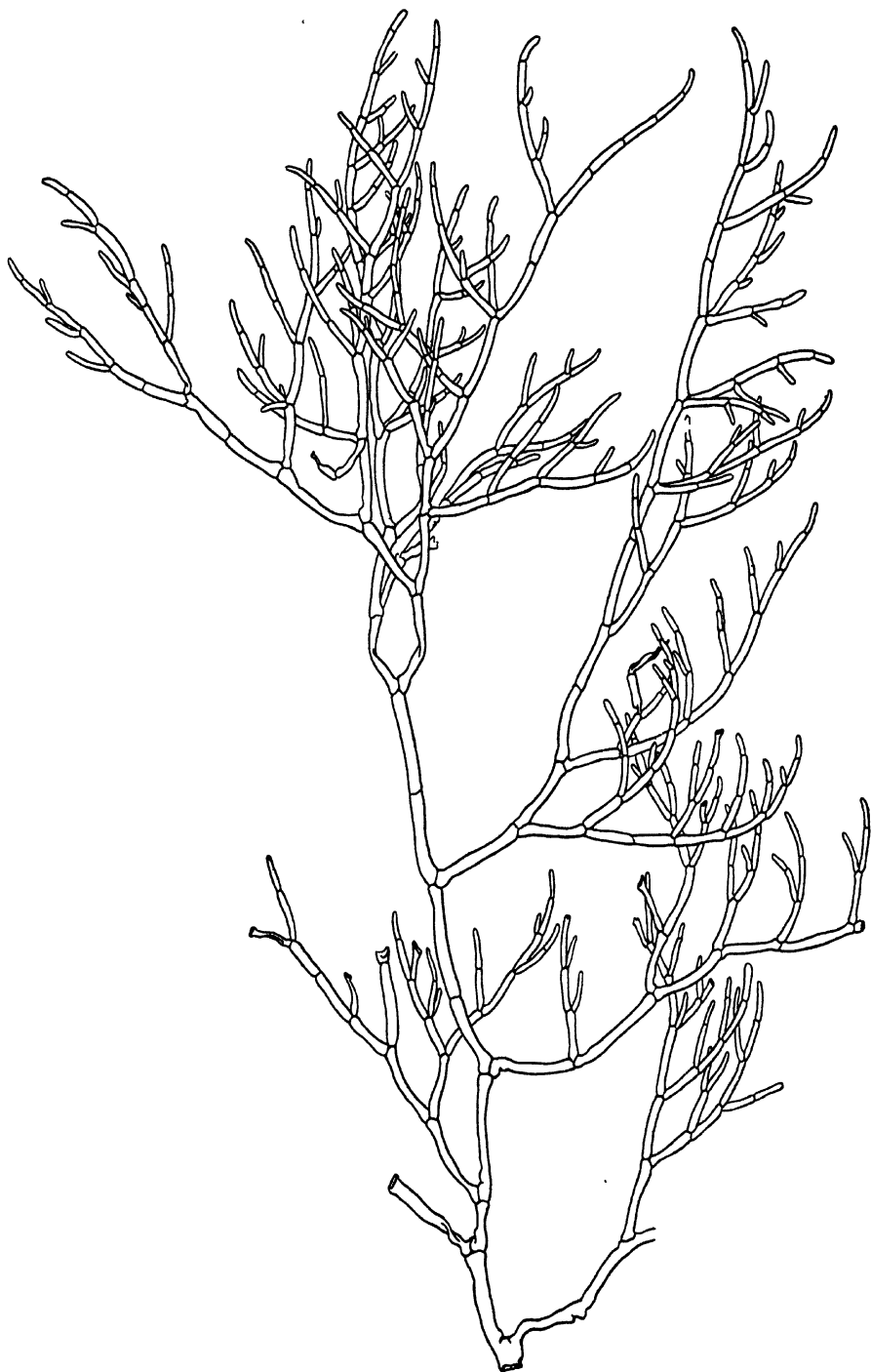


PLATE 10

Cladophora rhadina sp. nov.

- Fig. 1. Portion of plant to show filaments, branching, etc. (No. 5212).
× 8 diam.

Codium coronatum Setchell

- Fig. 2. View of plant (No. 5240) from above. Nat. size.
Fig. 3. Utricles, etc., of same plant. × 75 diam.
Fig. 4. Side view of plant (No. 5221). Nat. size.
Fig. 5. Utricles, etc., of same plant. × 75 diam.

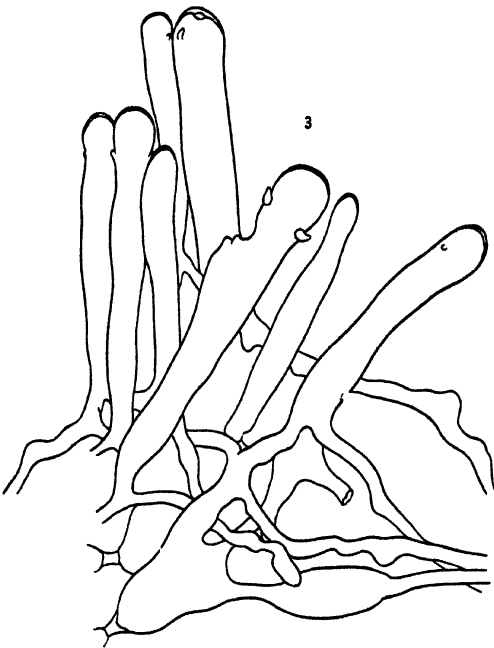
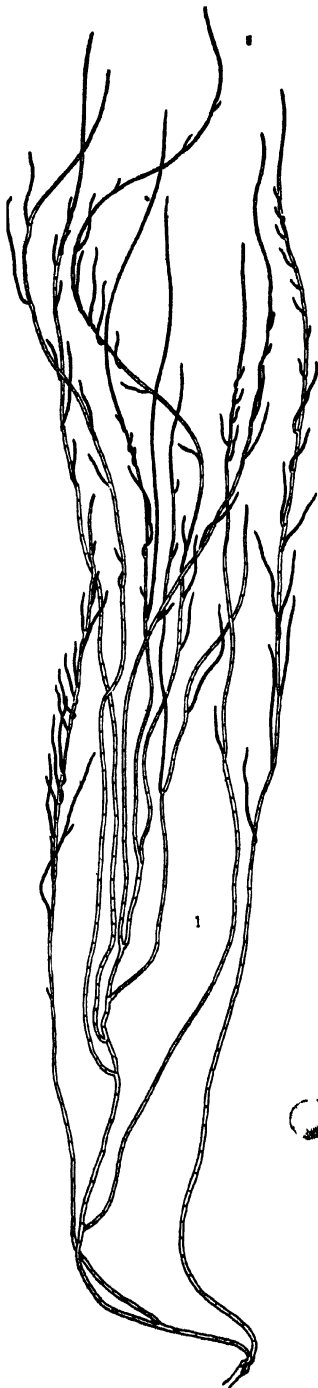


PLATE 11

Codium bulbopilum Setchell

Fig. 1 Utricles, etc. (No. 5241). × 75 diam.

Codium coronatum Setchell

Fig. 2. Utricles (No. 5241a). × 75 diam.

Fig. 3. Utricles, gametangium, etc. (No. 5241a). × 75 diam.

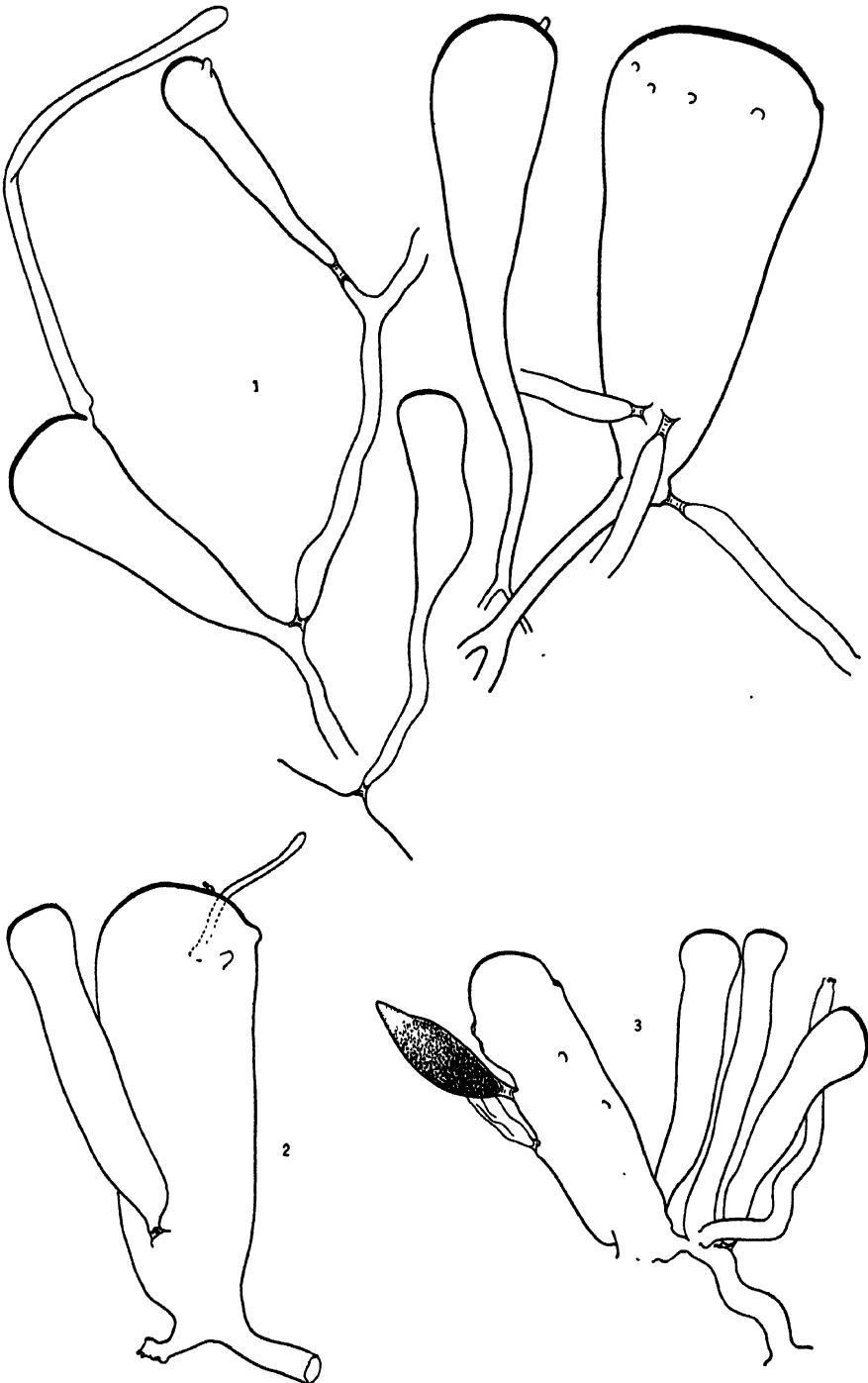


PLATE 12

Codium coronatum Setchell and *C. bulbopilum* Setchell

Fig. 1. Habit views of first (applanate species) and of the second (dichotomous species) (Nos. 5241 and 5241a). Nat. size.

Codium bulbopilum

Fig. 2. Habit of typical plant (No. Q). Nat. size.

Codium taitense Setchell

Figs. 3, 4. Utricles (No. 5102). $\times 75$ diam.

Codium coronatum Setchell

Fig. 5. Utricles and gametangia (No. J). $\times 75$ diam.

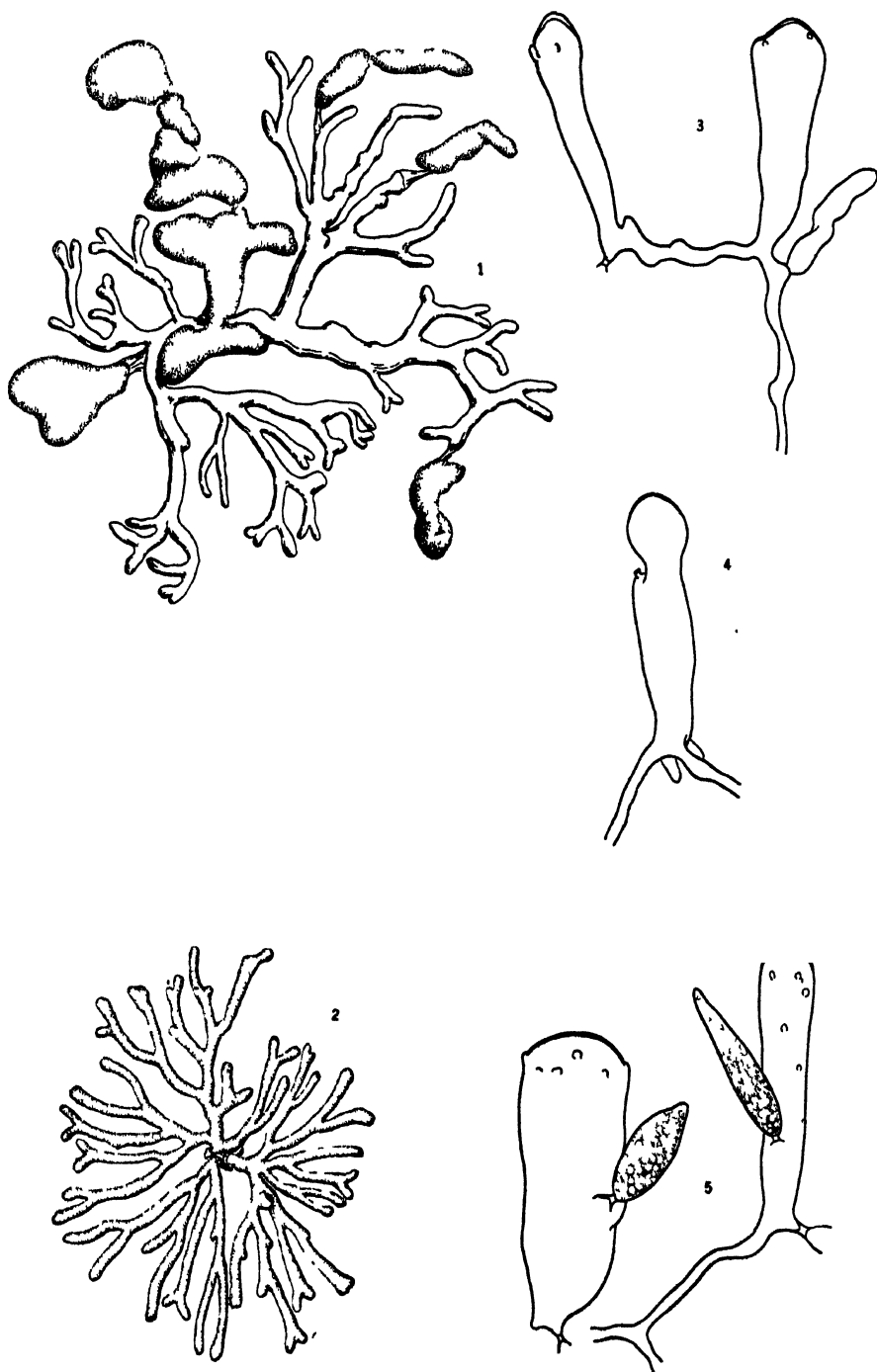


PLATE 13

Sphacelaria taitensis Setchell

- Fig. 1. Diagram of habit of typical plant above the base (No. 5252).
× 12.5 diam.
- Fig. 2. Tips of filaments with hairs (No. 5252). × 75 diam.
- Fig. 3. Portion of filament with propagula (No. 5252). × 75 diam.

Dictyota friabilis Setchell

- Fig. 4. Surface view of portions of a sterile plant (No. 5025). × 2 diam.
- Fig. 5. Portion of a fertile plant (No. 5025). × 2 diam.
- Fig. 6. Schematic view of arrangement of superficial cells at young dichotomy
(No. 5025). × 25 diam.
- Fig. 7. Transverse section of frond (No. 5025). × 187.5 diam.

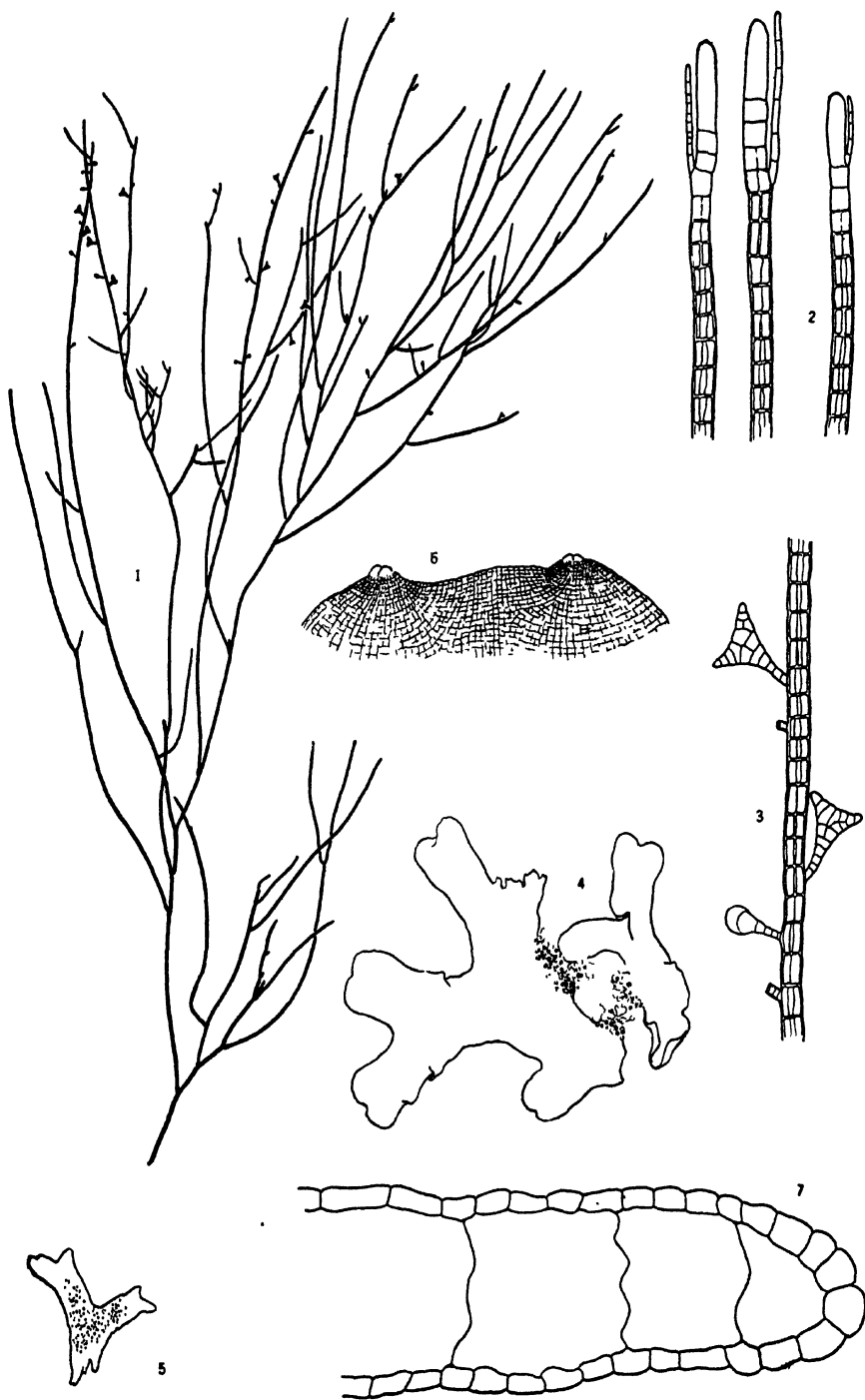


PLATE 14

Dictyota (?) hamifera Setchell

- Fig. 1. View of upper surface of portion of a typical plant (No. 5125) showing dichotomies and hamate lateral branches. $\times 2$ diam.
- Fig. 2. Schematic view of arrangement of superficial cells at apex of a short dichotomy, showing relation of heteromorphic division of the apical cells (No. 5125). $\times 25$ diam.
- Fig. 3. Enlarged view of one branch of the dichotomy shown in figure 2. $\times 375$ diam.
- Fig. 4. Enlarged view of superficial arrangement of cells of tip of a lateral hamate branch (No. 5125). $\times 375$ diam.
- Fig. 5. Transverse section of main frond (No. 5125). $\times 187.5$ diam.
- Fig. 6. Transverse section of lateral hamate branch (No. 5125). $\times 187.5$ diam.

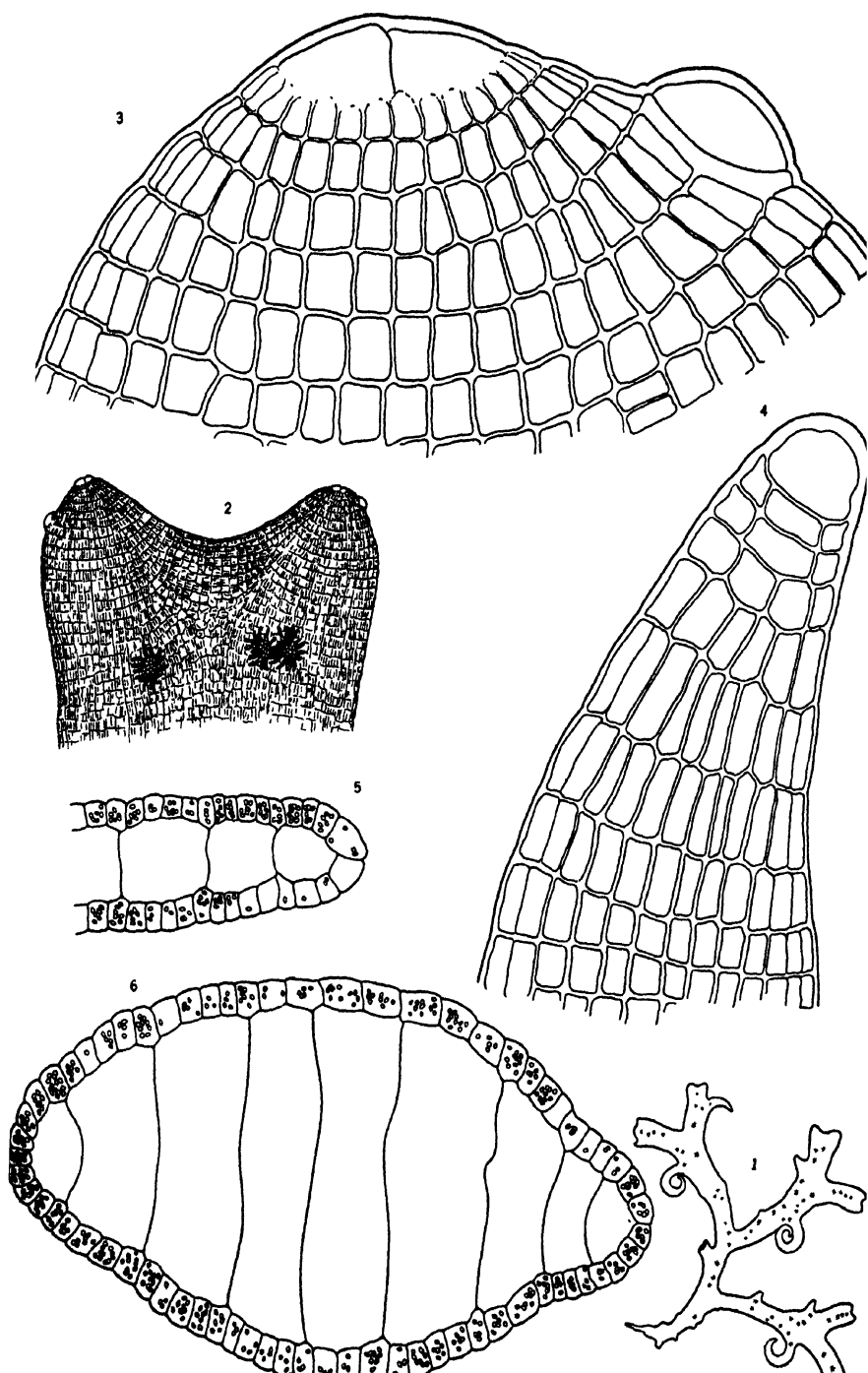


PLATE 15

Sargassum taitense Grunow

- Fig. 1. Upper portion of branch (No. 5000a). Nat. size.
Fig. 2. Inflorescence from lower down on same plant. $\times 1.5$ diam.

Sargassum sociale (Grunow) Setchell

- Fig. 3. Inflorescence (No. 5052). $\times 1.5$ diam.
Fig. 4. Axillary group of vesicles and leaflets (No. 5052). $\times 1.5$ diam.

Sargassum boraborensae (Grunow) Setchell

- Fig. 5. Branchlet with leaves and inflorescences (No. 5124). $\times 1.5$ diam.

Sargassum mangarevense (Grunow) Setchell

- Fig. 6. Inflorescences (No. 5153). $\times 1.5$ diam.



PLATE 16

Sargassum mangarevense (Grunow) Setchell

Fig. 1. Tip of branch, showing leaves, vesicles, and inflorescences (No. 5156).
Nat. size.

Figs. 2, 3. Two inflorescences (No. 5156). $\times 2$ diam.

Fig. 4. Tip of branch (No. 5153). Nat. size.

Fig. 5. Two inflorescences (No. 5223). $\times 2$ diam.

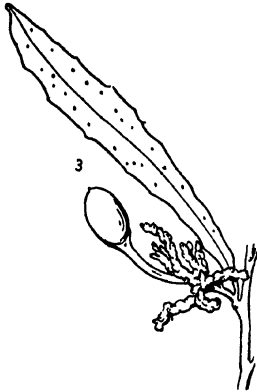


PLATE 17

Gelidium samoense Reinbold

Fig. 1. Habit sketches of characteristic plants (No. 5109a). $\times 4$ diam.

Fig. 2. Section through frond (No. 5109a). $\times 375$ diam.

Gelidium samoense f. *lineare* Setchell

Figs. 3-5. Habit sketches (No. 5109a). $\times 4$ diam.

Fig. 6. Section through frond (No. 5109a). $\times 375$ diam.

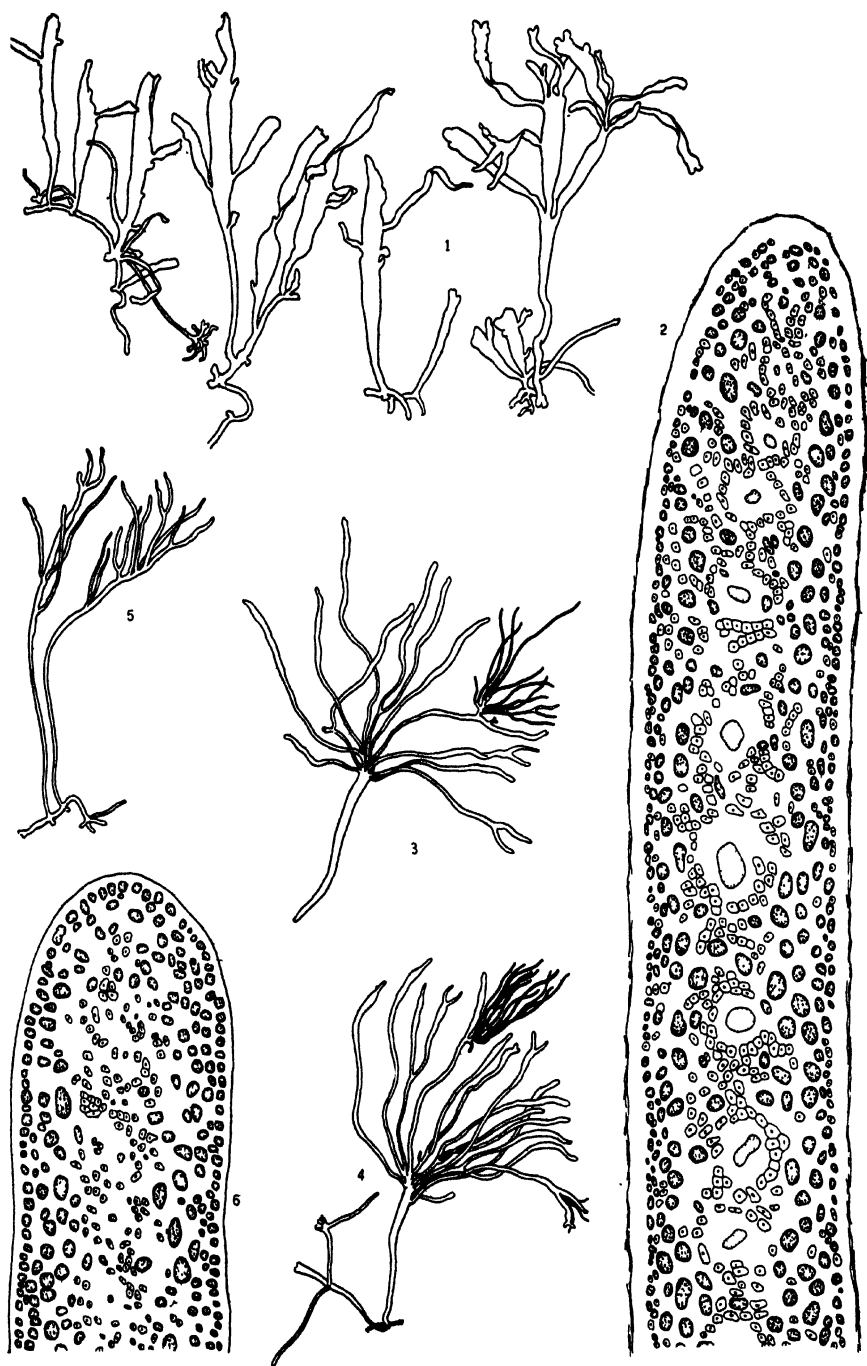


PLATE 18

Gelidium acrocarpum Harv.

- Fig. 1. Habit sketch to show variation in external form (No. 5184). Nat. size.
- Fig. 2. Habit sketch to show variation in general form (No. 5192). Nat. size.

Hypnea nidifica J. Ag.

- Figs. 3-5. Habit sketches for comparison of variation in form (No. 5193).
× 4 diam.
- Figs. 6, 7. Branches with branchlets showing sori (No. 5193). × 25 diam.

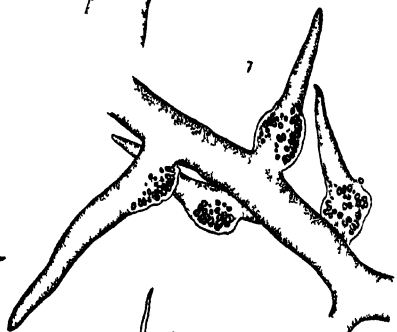
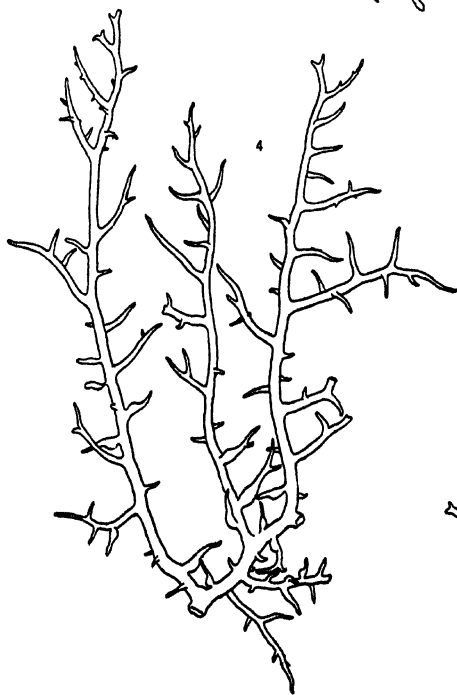
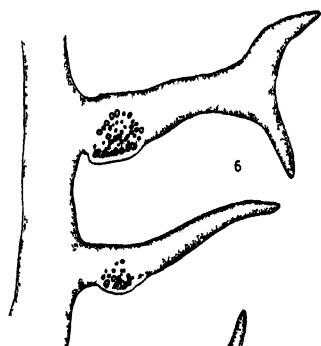
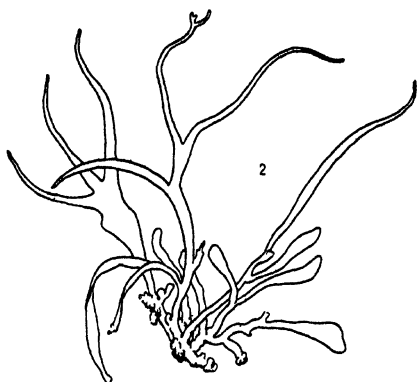


PLATE 19

Laurencia flexilis Setchell

Figs. 1-3. Habit sketches to show variation in form and condition (No. 5246). Nat. size.

Fig. 4. Upper portion of antheridial plant (No. 5104*a*). $\times 5$ diam.

Fig. 5. Upper portion of tetrasporic plant (No. 5051*b*). $\times 5$ diam.

Fig. 6. Cluster of antheridia (No. 5104*a*). $\times 250$ diam.

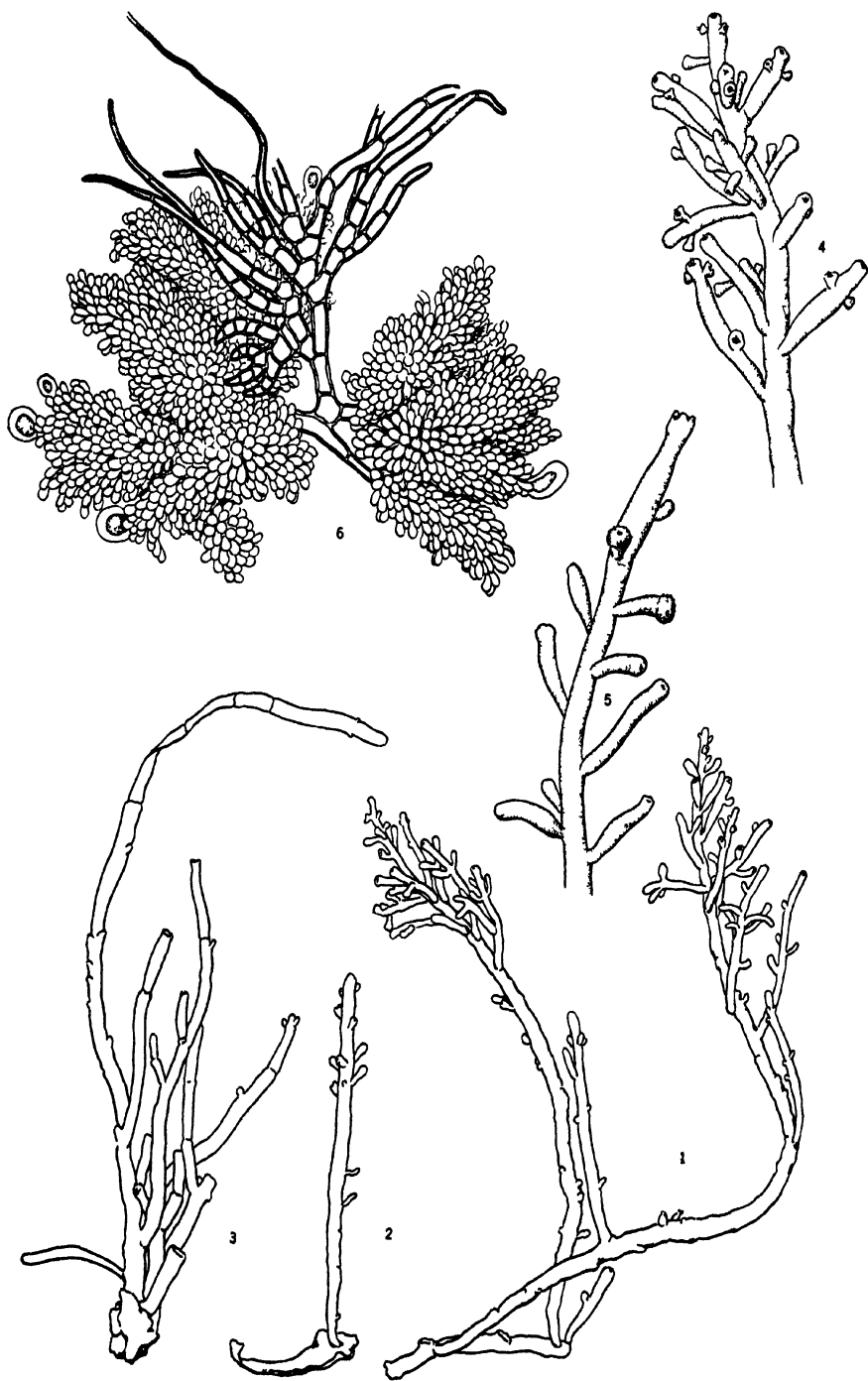


PLATE 20

Dictyota friabilis Setchell

Fig. 1. Portion of surface of the frond showing surface cells and "tetrasporangia" (No. 5025). $\times 75$ diam.

Herposiphonia parca Setchell

Fig. 2. Side view of a filament (No. 5224b). $\times 6.25$ diam.

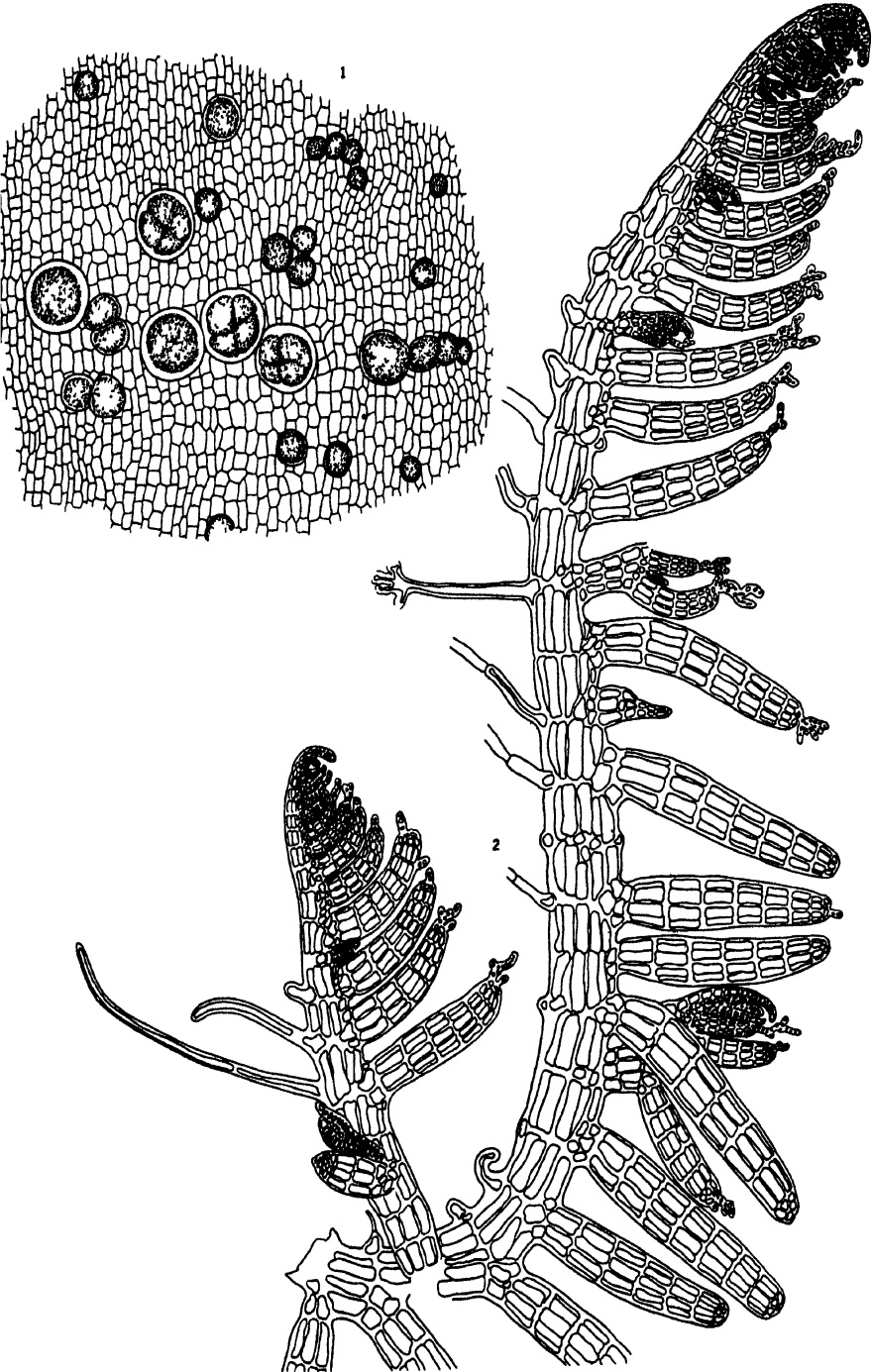


PLATE 21

Bostrychia exigua Setchell

- Fig. 1. Habit sketch of portion of a characteristic tetrasporic plant (No. 5224*d*). $\times 62.5$ diam.
Fig. 2. Tetrasporic branch (No. 5224*d*). $\times 187.5$ diam.

Lophosiphonia sparsa Setchell

- Fig. 3. Upper portion of a plant (No. 5224*c*). $\times 62.5$ diam.
Fig. 4. Tetrasporic branchlets (No. 5224*c*). $\times 62.5$ diam.

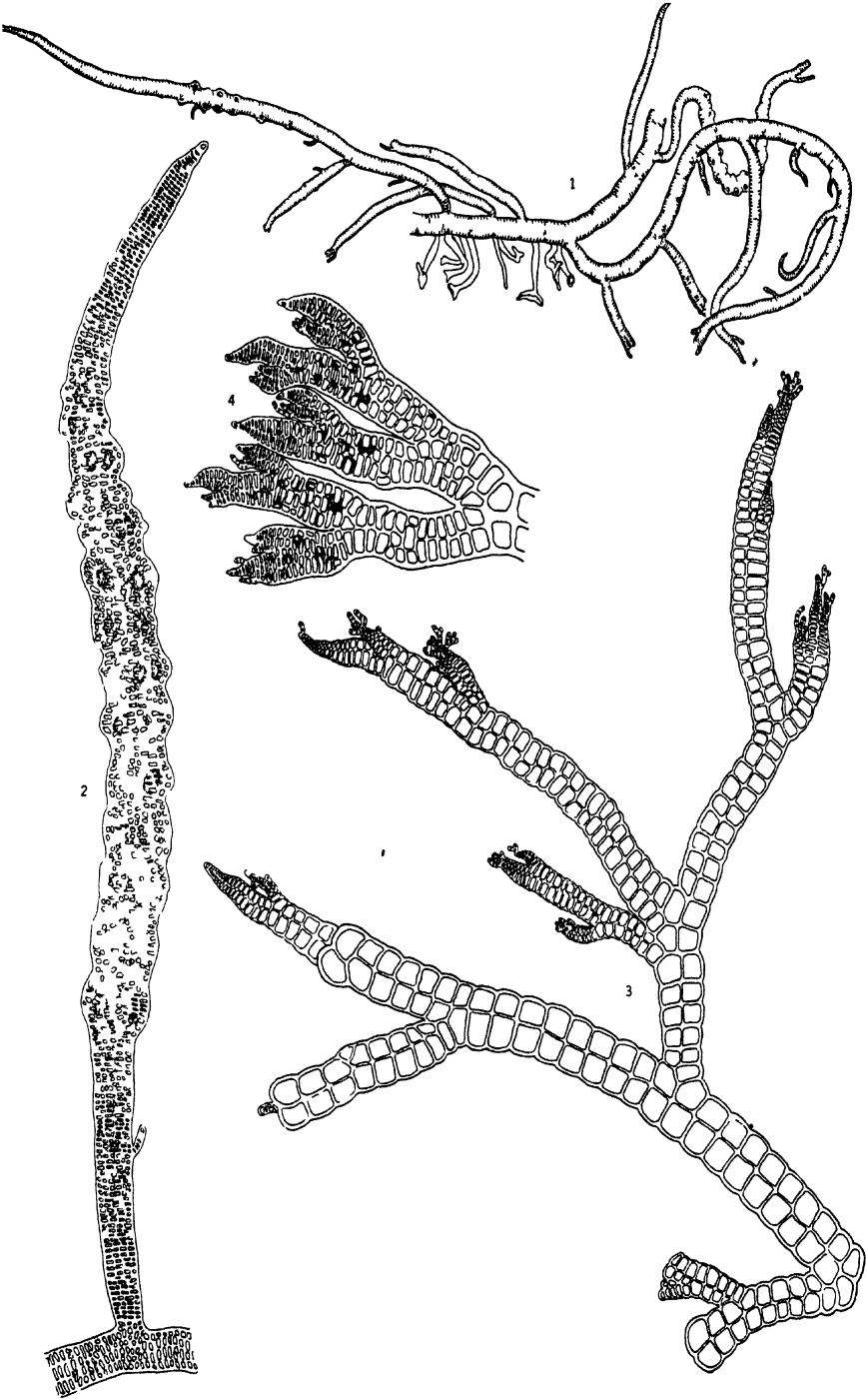


PLATE 22

Cladophora inserta f. *ungulata* (Brand) Setchell

Fig. 1. Sketch of upper portion of a branch (No. D). $\times 12.5$ diam.

Ceramiothamnion Codii Richards?

Fig. 2. Portion of a tetrasporic branch (No. J). $\times 32.5$ diam.

Cladhymenia pacifica Setchell

Fig. 3. Habit sketch of cluster of plants (No. 5220). Nat. size.

Fig. 4. Habit sketch of upper portion of a plant with young tetrasporangia (No. 5220). $\times 5$ diam.



TAHITIAN SPERMATOPHYTES
COLLECTED BY W. A. SETCHELL, C. B. SETCHELL,
AND H. E. PARKS

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The following list of Spermatophytes records principally the collections made by Mrs. Setchell, Mr. H. E. Parks, and myself, during a visit to the Island of Tahiti during the months of May, June, and July in the year 1922. Since our attention was more particularly directed to marine plants, the land flora absorbed only such energy and time as could be spared from our main interest. Consequently, we were able to visit only the more accessible portions of the island and came into contact chiefly with the introduced plants or with indigenous species of the levels below 3000 feet in altitude. The greater portion of the peculiar endemic species were not to be obtained in these lower levels, and much of the material collected consisted of plants which have been introduced into Tahiti since the advent of Europeans and other foreigners. Little has been recorded as to the occurrence of these plants in Tahiti and it seems best to enumerate the species encountered by us, together with such notes as may seem of interest.

I have compared our list with that of Pancher in Cuzent's "Tahiti" in 1860, since he is the only one who has noted the introduced plants and who has given any suggestion as to the dates of their introduction. I have also referred to Nadeaud's *Plantes Usuelles des Tahitiens*, 1864, his *Enumération des plantes de l'île de Tahiti* 1873, and his last contributions, *Plantes rares ou peu connues de Tahiti* (*Jour. de Bot.*, vol. 11, pp. 103-120, 1897), and his *Plantes nouvelles des îles de la Société* (*ibid.*, vol. 13, pp. 1-8, 1899); to Drake del Castillo's *Flore de la Polynésie française*, 1893, and, in general, to the works dealing with Tahitian Spermatophytes mentioned in the last; but especially to the valuable notes in Guillemain's "Zephyritis Taitensis" (*Ann. Sci. Nat., Bot.*, 1836-1837).

I have been able to prepare this list largely through the kindness of specialists, to whom I desire to express my most sincere appreciation of their courtesy and helpfulness: to Dean Elmer D. Merrill, I owe

the determination, at least provisional, of the bulk of the species listed; to Dr. A. S. Hitchcock, the determination of the Gramineae; to Dr. R. Schlechter, the determination of the Orchidaceae; to Dr. Paul C. Standley, determinations of various Mexican immigrants into Tahiti; and to Mr. J. Frank Stimson, revision of the orthography of various Tahitian plant names.

PINACEAE

***Agathis vitiensis* (Seem.) Benth. et Hook.**

392. A fine row of large trees in the "Experimental Gardens" at Papeete, June 19 (without flowers or fruits). Cultivated; originally from the Fiji Islands.

***Araucaria Cookei* R. Br.?**

At various places about Papeete, fine large trees were seen, seemingly belonging to this species. Some very fine specimens were noted near the Customs Offices. Pancher (cf. Cuzent, 1860, p. 239) states that this species was introduced into Tahiti from New Caledonia by Lieut. M. Ferré about 1856. He also states that *A. excelsa* was introduced by M. Notte in 1835 and *A. Cunninghamii* by Dr. Johnstone in 1845.

TYPHACEAE

***Typha domingensis* Pers.**

Forming extended and dense patches of considerable area and 12-15 feet high, edge of lagoon moat, District of Faava, May 27 (with flowers and fruits). Introduced; originally described from the West Indies.

A passing native gave me the name "'Opaero" (as corrected by Mr. Stimson) and stated that the inflorescence is eaten. Pancher notes the introduction of a *Typha* in 1830, by Masette (cf. Cuzent, 1860, p. 241). He also confirms the native name.

PANDANACEAE

***Freycinetia demissa* Brown and Bennett**

180. On dripping rocks above the caves at Maraa, District of Paea, May 29 (only dark green pistillate spikes, no staminate plants seen!), this station only 25–30 feet above tide level. 207. At about 2000 ft. altitude, Fautaua Valley, May 31 (with light lemon yellow fruits, inner bracts of nearly the same tint, and outer bracts yellow only at their bases); endemic, occurs in practically all valleys, but only sterile plants met with by us, other than the foregoing.

So far as any definite information is concerned, there is only a single species of *Freycinetia* known from Tahiti, although Nadeaud (Jour. de Bot., vol. 2, p. 116, 1897) speaks of a “variete *Violette*” with purple stems and bases of leaves, as being plentiful. It extends from near sea-level to about 3000 feet (cf. Nadeaud, 1873, p. 40).

It seems best to use the name *Freycinetia demissa* Brown and Bennett (Pl. Rar. Jav., p. 33, 1838), although the description is fragmentary. Kunth (Enum. Pl., vol. 3, p. 104, 1841) cast the statements of Brown and Bennett into diagnostic form. About 1853 or 1854, Hombron’s magnificent plate of his *Victoriperrea impavida*, with full analyses of his figures, was published in the second volume of the Botany of Dumont D’Urville’s Voyage au Pol. Sud. This publication is sufficient to validate Hombron’s name, which would take precedence of Solms Laubach’s *Freycinetia Victoriperrea* (Linnaea, vol. 47, p. 103, 1878) which is founded entirely on Hombron’s plate and analyses.

Warburg (in Engler, Pfl.-reich, vol. 4, 9 (Heft 3), p. 38, 1900), and Martelli (Webbia, vol. 3, p. 326, 1910) use the binomial of Solms, while Bennett and Brown (*loc. cit.*), Seeman (Fl. Vit., p. 283), Nadeaud (1873), Drake del Castillo (1893), etc., use *Freycinetia demissa*. The species was first collected by Solander on Cook’s first voyage and named and described but never published, as *Pandanus demissus* Solander.

The Tahitian names are “*Ie’ie*” and “*Farepepe*” (Nadeaud, 1870, p. 287, and Pancher, in Cuzent, 1860, p. 241). According to reports, the thick tangles of this species are overrunning the patches of “*Fe’i*” (*Musa Fehi*) in some of the districts where the former village control has relaxed and is one of the factors in constantly diminishing the supply of this valuable native food material. The more pessimistic even prophesy the entire blotting out of the “*Fe’i*” supply before many years.

Pandanus tectorius Soland.

367. Tree, edge of strand at the village of Arue, June 16 (with nearly ripe fruit). Indigenous; a common strand species throughout the tropics of the Pacific and Indian oceans.

This seems to be the common strand species in Tahiti and has smaller strobili than the next, which is also a strand tree. Whether *P. Macfarlanei* Martelli and *P. Drolletiana* Martelli, both endemic to Tahiti, are also strand trees or grow higher on the slopes is not mentioned. The general Tahitian name is "*Fara*," corresponding to the "*Fala*" of the Samoans and the "*Hala*" of the Hawaiians. Pancher says that the native name of the form without prickly leaves is "*Irii*." The Tahitians still employ the leaves for various purposes.

Pandanus tahitensis Martelli

367. A single large tree by the bridge (and ford) near Papawa Harbor, June 16 (in nearly ripe fruit). 544? Edge of strand near the village of Atiue and near Tapuna Pass, July 8 (staminate with ample inflorescence and exceedingly fragrant). Endemic.

GRAMINEAE

***Bambos vulgaris** Schrad.

191. Along the trail, near the fort, Fautaua Valley, May 31 (without flowers or fruit). Introduced; originally described from Mexico, and more commonly known as *Bambusa vulgaris* Schrad. Bamboos are common and of several species in gardens, but along the trails this species seems to be the more prevalent. At the fort, there was earlier an extensive garden. Pancher (Cuzent, 1860, p. 241) gives only "*Bambusa arundinacea*," which appears however to be *Schizostachyum glaucifolium* (Rupr.) Munro.

***Eragrostis amabilis** (L.) W. and A.

44. Among coconuts, District of Faaa, May 22 (in flower). Introduced; originally described from India, more commonly known as *Eragrostis plumosa* Link and *E. tenella* R. and S.

This is a fairly frequent grass in shade. Drake del Castillo (1893, p. 262) gives only *E. pilosa* Beauv. as occurring in Tahiti.

***Centotheca latifolia* (Osbeck) Trin.**

415. Roadside, District of Papeari, June (in fruit). Indigenous or introduced early; originally described from the East Indies and accredited to the Society Islands by Forster (Prodromus, p. 8, 1786, sub *Poa latifolia*). Nadeaud states (Pl. Usuelles des Tahitiens, 1864, p. 3) that the Tahitians called it "*Oheohe*" and used it in their vulneraries. It is more commonly known as *Centotheca lappacea* Desv.

***Sporobolus indicus* (L.) R. Br.**

150. Sandy soil, roadsides, District of Punaauia, May 26 (in fruit). Introduced; South American.

This is called "New Zealand Grass" and is said to be of very recent importation. It is regarded as a pest and it is said that cattle will not eat it.

***Eleusine indica* (L.) Gaert.**

95. Low, moist places by roadsides; frequent. Ahonu Valley, District of Mahina, May 23 (in fruit). Introduced; originally described from India.

***Dactyloctenium aegyptium* (L.) Richt.**

64. In patches, along seashore, District of Arue, May 22 (in fruit). Introduced; originally described as pantropic.

***Capriola Dactylon* (L.) Kuntze**

45. Low, moist places by roadsides; frequent. District of Faaa, May 22 (in flower). Introduced; originally described from southern Europe and more commonly known as *Cynodon Dactylon* Pers.

The native name is "*Matie*."

****Holcus sorghum sudanensis* (Piper) Hitchcock**

46. In clumps, 5-7 feet high, wayside on rocky ground, frequent in the District of Faaa, May 22 (in fruit). Escaped from cultivation, originally from Africa (?). A native gave me the name of "*Toroo*," but an older Tahitian, well acquainted with the names of plants, did not recognize it, according to J. Frank Stimson. The resemblance to "*To*," or sugar-cane, may be implied. It is more commonly known as *Andropogon sorghum* var. *sudanensis*.

Pandanus tectorius Soland.

367. Tree, edge of strand at the village of Arue, June 16 (with nearly ripe fruit). Indigenous; a common strand species throughout the tropics of the Pacific and Indian oceans.

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The native name is "*Matie*."

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***Coix lachryma-jobi* L.**

35. Roadsides, frequent, District of Faaa, May 22 (in fruit). Introduced; originally described from the East Indies.

The native name is "*Poepoe*." Neither Nadeaud nor Pancher (in Cuzent) names this as native and Drake del Castillo (1893, p. 254) mentions only the Wilkes Expedition as authority for its occurrence in Tahiti.

***Syntherisma pruriens* (Trin.) Arthur**

364. Scattered in sandy patches among cobbles, dry bed of Punaruu River, June 15 (in fruit). Introduced(?); originally described from the Marquesas and from Hawaii and more commonly known as *Digitaria pruriens* Buese.

****Stenotaphrum secundatum* (Walt.) Kuntze**

108. Along roadsides in moist situations, plentiful, Tahara Mountain, District of Mahina, May 23 (in fruit). Introduced(?); shore plant, pantropic, originally described from southeastern United States.

****Paspalum conjugatum* Bergius**

84. Roadsides, in moist places, Tapahi, District of Mahina, May 23 (in fruit). Introduced; originally described from Dutch Guiana.

****Paspalum paniculatum* L.**

50. Roadsides, frequent, District of Faaa, May 22 (in fruit).
370. In yard of residence, Papeete, June 16 (in fruit). Introduced; originally described from South America.

A Tahitian name for this is "'Ofe 'Ofe," probably a general rather than a particular name. In Samoa a very similar name is applied to the native Bamboo or *Schizostachyum glaucifolium* (Rupr.) Munro, which in turn is "'Ofe" or "'Ohe" to the Tahitians.

***Oplismenus compositus* (L.) Beauv.**

175. In shadow of cliff, roadside, District of Faaa, May 27 (in flower). Indigenous or introduced early; originally described from Ceylon.

It is noted from Tahiti by Solander under *Panicum unguinosum* (Seeman, Fl. Vit., p. 325) and was collected on Cooke's first voyage (1769).

Oplismenus undulatifolius imbecillis (R. Br.) Hack.

85. Roadsides, in damp places, Tapahi, District of Mahina, May 23 (in fruit). Introduced early(?); the variety originally described from Australia but the species originally described from Europe.

This species has been known in Tahiti since the time of D'Urville's Expedition (1822-1825) and has passed under the name of *O. setarius* R. and S. Nadeaud (1873, p. 223) gives the Tahitian name as "*Papapapa*."

***Echinochloa colonum** (L.) Link

102. Frequent in moist meadows, Ahonu Valley, District of Mahina, May 23 (in fruit). Introduced; originally described from India.

Cenchrus Hillebrandianus Hitchcock

62. Very common along the shore in the Arue District, May 22. Indigenous, but seemingly introduced; originally described from Hawaii but specimens also indicated from Tahiti and from Easter Island. Hitchcock (Mem. Bishop Mus., vol. 8, No. 3, p. 213) mentions that it may be the same as *C. laniflorus* Steud. from Tahiti, but is unable to make certain. It may be that the reference of *C. echinatus* L. to the Tahitian flora is based entirely or in part on this species. I was given the Tahitian name "*Pipi*" for this species, presumably in error for "*Piri*." "*Piripiri*" or "*Pilipili*" is the usual name for adhesive grasses or other slender herbs in many islands of Polynesia. "*Pipi*," however, may have been applied because of the globular fruits of this species, as the name is usually given to various Leguminosae with globular or circular seeds.

Cenchrus calyculatus Cav.

88. Mixed with other grasses, roadsides, Tapahi, District of Mahina, May 23 (in flower). 469. Roadsides, Urihori Village, District of Vairao, June 24 (in late anthesis). Probably indigenous but appearing as if introduced. Originally described from Tonga (Friendly Islands).

***Andropogon aciculatus* Retz.**

110. Plentiful along roadsides, Tahara Mountain, District of Mahina, May 25 (in fruit). Introduced early, or indigenous; originally described from the East Indies.

Nadeaud (1873, p. 32) gives "*Papapapa*" as the Tahitian name of this species.

***Saccharum officinarum* L.**

94. On dry slopes along wayside, Tapahi, District of Mahina, May 23 (in flower). 535. In large clumps, 18-20 feet high, knife-like ridge between two forks of the Fautana River below the Diadem, July 8 (in flower). Introduced (?).

The sugar-cane was early cultivated in Tahiti, but not abundantly and was left to infants and boys, as George Forster says (*De Plantis Esculentis*, etc., p. 77, 1786), nor was it spontaneous as it is now. Cuzent (1860, p. 242) enumerates eight varieties and considers it indigenous, as does also Nadeaud (1873, p. 32). The native names are "*Toro*" and "*To*." Nadeaud (*loc. cit.*) gives "*To*" as the native name with eight qualifying names for the several different varieties, distinguished from one another by differences in the color of the leaves and stems or in consistency of the fibrous envelope. At the present time sugar production in Tahiti is barely sufficient for the local supply.

CYPERACEAE

****Cyperus rotundus* L.**

328. Sunny, dry soil, Papeete, frequent (abundant also in District of Faaa), June 10 (in flower). Introduced; pantropic, originally described from India.

****Cyperus flabelliformis* Rottb.**

149. Low, swampy land along roadside, near Outo-maoro, District of Punaauia, May 26 (in flower). Escaped from cultivation; originally described from southwestern Asia and adjacent Africa.

***Cyperus compressus* L.**

65. Seashore in Arue District, May 22 (in flower). Introduced; pantropic, originally described from North America.

***Pycreus odoratus* (L.) Urb.**

94. Moist places, wayside, Tapahi, District of Mahina, May 23 (in flower). 263. Moist ground, near lighthouse at Point Venus, June 4 (in flower). Introduced; pantropic, more commonly known as *Pycreus polystachyus* Beauv.

***Mariscus pennatus* (Lam.) Merr.**

36. Moist places, roadsides, frequent, District of Faaa, May 22 (in fruit). Introduced; Old World tropics, more commonly known as *Mariscus albescens* Gaudich. Nadeaud (1873, p. 33) states that the natives call this "*Mo'u Ha'ari*" and use it to filter off the expressed juice of the coconut.

***Mariscus umbellatus* Vahl**

58. Moist places, frequent, District of Faaa, May 22 (in flower). 263. Wet bank by roadside, District of Tiarei, June 5 (in flower). 335, 337. In dry stream bed and along trail. Orofere Valley, June 13 (in flower). 510. Moist meadow, Papara District, July 5 (in flower). Indigenous(?); Old World tropics, originally described from the East Indies.

***Mariscus samoensis* Boeckl.**

263. On shaded rocks, Fautaua Valley, June 3 (in fruit). 284. Roadside in District of Tiarei, June 5 (in fruit). 336. Along trail up the Orofere Valley, June 13 (in flower). Indigenous(?); originally described from Samoa. May possibly be the *Cyperus flavus* of Drake del Castillo (1893, p. 240).

***Kyllingia monocephala* Rottb.**

96. Moist places, waysides, abundant, Tapahi, District of Mahina, May 23 (in flower and fruit). 255. In earth among rocks, Fautaua Valley, June 3 (in flower and fruit). Indigenous or introduced early; Old World tropics. Tahitians call it "*Matie upo'o*" and (*vide* Nadeaud, 1873, p. 33) "*Mo'u upo'onui*."

****Kyllingia intermedia* R. Br.**

33. Moist places, frequent, Faaa District, May 22 (in flower). 100. In wet meadows, Tapahi, District of Mahina, May 23 (in flower). Introduced(?); Formosa, Philippines, Samoa, Australia; originally described from the last.

***Eleocharis caribaea* (Rottb.) Blake**

133. On dripping banks, sparse, Tapahi, District of Mahina, May 25 (in fruit). 267, 269. Dripping rocks, various localities between Papenu and Huau, June 5 (in fruit). 262, 263. Among grass, bank of Punaruu River, June 15 (in fruit). Pantropic; usually noted under *E. capitata* (L.) R. Br. recently (1918) determined to be the proper binomial for the plants hitherto referred to *E. tenuis* (Schultes) Willd., whose distribution is Atlantic American.

***Fimbristylis annua* (All.) R. and S.**

142. Abundant along roadside between Papenu and Huau, May 25 (in fruit). 264. Moist ground near lighthouse at Point Venus, June 4 (in fruit). Pantropic; credited to Tahiti under the synonym *F. diphylla* Vahl.

****Fimbristylis cymosa* R. Br. var. *umbellato-capitata* Hillebr.**

285. Forming tufts on maritime rocks otherwise destitute of vegetation, near Faarapa, District of Papenu, June 5 (in fruit). Polynesian-Australian species, the variety described from Hawaii (often confused with *F. spathulacea* Roth).

PALMAE***Cocos nucifera* L.**

The Coconut Palm is omnipresent along the seashore and narrow coastal plains of Tahiti and varies in size and shape of nuts. The natives now call it "*Ha'ari*," although the name "*Niu*," common in Polynesia, seems to have been employed earlier. The name "*Ha'ari popa'a*" or "White man's coconut," seems to be used for the cultivated Betel-nut Palm (*Areca catechu* L.) which is planted in ornamental gardens. Other palms are cultivated but opportunity for study was lacking.

ARACEAE

Cyrtosperma Chamissonis (Schott.) Merr.

410. A single plant by roadside near native dwelling, Maraa, June 21 (without flowers or fruit). Probably planted. Originally described from Radak Island. The native name is "'Ape," but I could not find out that the plant is used for any purpose.

Alocasia macrorrhiza (L.) Schott

230. Near mouth of cave at Maraa, June 2 (without flowers or fruit). Escaped from cultivation; originally described from India.

Colocasia esculentum (L.) Schott

The Taro is cultivated, but not extensively. Its place in native economy seems at present to be taken by yams and by Fe'i in addition to the Breadfruit.

There was a noticeable absence of climbing Aroids, except two under cultivation, namely:

Scindapsus (*Pothos*) *aureus* (Lind. and Andre) Engler was observed in a garden at Tahara Mountain and was said to have been brought from Honolulu.

Monstera deliciosa Liebm., as it seemed to be, was fairly common in cultivation.

COMMELINACEAE

***Commelina nudiflora** L.

59. Very abundant in moist ground, District of Faaa, May 22 (in flower). Introduced; pantropic, used for horse fodder.

The occurrence of this very common weed is not mentioned by Cuzent, Nadeaud, or Drake del Castillo, although it seems possibly of long occupation. Pancher (in Cuzent, 1860, p. 24) mentions a "*Commelyna?* . . . Bresil, 1850, Admiral Bonard," which may be this but it is doubtful.

PONTEDERIACEAE

****Eichornia crassipes* Solms.**

238. In borders of brooks and in ditches, Papeari, June 2 (in flower). Introduced; pantropic, originally from tropical America. It was also noted in the District of Arue.

LILIACEAE

***Taetsia fruticosa* (L.) Merr.**

127. Frequent in moist, shady gulches, Tapahi, District of Mahina, May 25 (without flowers or fruit). 498. Above the falls, Maara Valley, District of Papeari, June 29 (in bud). Indigenous. The Tahitian name is "*Ti*," but a passing Tahitian at Tapahi named my No. 127, "*Oute*." It is more commonly known as *Cordyline terminalis* Kunth.

Cultivated species were collected as follows:

Pleomele (Dracaena) aurantiaca (Wall.) N. E. Br. (in fruit only), from Malay Peninsula. No. 368.

Sansevieria zeylanica Auct. (*S. Roxburghiana* Schultes, see N. E. Br. in Kew Bull., 1915, p. 227). No. 386.

AMARYLLIDACEAE

***Crinum asiaticum* L.**

317. Seashore, and often planted as hedges or singly, District of Tiarei, June 9 (in flower). Cultivated, but persistent; originally from Ceylon. The stout caudex is often two or more feet high, the leaves are 3 to 4 feet long, the peduncles 2 to 3 feet high, with flowers about 10 inches long. The petals are white and the staminal filaments are white below but deep red above. Varieties in gardens were noted in which the limb of the corolla was red. The Tahitian name is "*Eriri*," or Lily.

Pancher (cf. Cuzent, p. 240) states that *C. erubescens* was introduced by Johnstone in 1845.

Eucharis grandiflora Planch. and Linden

377. Cultivated, Papeete, June 16 (in flower). Originally described from tropical America.

TACCACEAE

Tacca pinnatifida Forster

109. Moist, shaded ground, abundant, District of Mahina, beyond Tahara Mountain, May 25 (without flowers or fruit). Relic of former cultivation; originally described from the Society Islands. The Tahitian name is "*Pia*," as it is elsewhere in Polynesia.

Nadeaud (1873, p. 35, No. 257) says that there are certain varieties known to the natives which differ only in the leaf incision and height of stem.

DIOSCOREACEAE

Dioscorea bulbifera L.

130. Climbing over trees, road along Tapahi Cliff, District of Mahina, May 25 (without flowers or fruit). Indigenous.

This plant has a short, stout, bifurcated purplish-brown tuber with bright bluish-purple flesh. Aerial tubers were small but abundant. The Tahitian name is "*Hoi*."

Dioscorea alata L.

241. Cultivated crop, District of Papara, June 2 (with staminate flowers). 242. Edge of cultivated fields, Fautaua Valley, June 3 (without flowers or fruits but with aerial bulblets). 311. At about 2500 ft. elevation, Orofere Valley (without flowers or fruits but with aerial bulblets). Cultivated throughout the tropics. The Tahitian name is "*Uhi*." Several cultivated varieties of *Dioscorea sativa* are sold by the Chinese in the Papeete market.

MUSACEAE

Musa Fehi Bertero

347. Upper Orofere Valley, about 2500 ft. altitude, June 13 (in fruit). 440. Lower end of Maara Valley, District of Papeari, about 50 ft. altitude, June 22 (in fruit). 526. At about 2200 ft. altitude, upper Fautaua Valley on the face of "The Diadem," July 8 (in fruit). 549-553. Cultivated, Papeari District, July 12 (in fruit). Indigenous; originally described from Tahiti.

The species of *Musa* with erect instead of drooping inflorescences range from southeastern Asia to Australia and on to the Society Islands. It is an unsettled question as to just how many species may be represented. The Asian form generally referred to *M. uranoscopus* Rumph. or *M. Troglodytarum* L., reduced by Schumann (Engler, Pfl.-reich, IV (1 Heft), p. 24, 1900) to a subspecies of *M. paradisiaca* L. and as having nothing to do with the other species with erect inflorescence often referred to it is properly *M. uranoscopus* Lour. (non Rumpf.). *Musa lasiocarpa* Franch. from China is also considered distinct. *Musa Hillii* F. Müll. from Queensland, Australia, differs in non-stoloniferous habit and in floral characters from *Musa Fehi* Bertero from Tahiti, Rarotonga, New Caledonia, and possibly also from Fiji and Samoa.

The Fe'i are of the greatest interest ethnobotanically since much of the food of the Tahitians still comes from the natural plantations in the upper valleys. As to the possible production of seeds which the natives call "stones" and which they believe are taken up by the plants from the earth, this seems to be still undecided. I was informed that Dr. Nadeaud claimed to have raised young Fe'i from seeds. They were scarce during my stay in Tahiti but I received specimens containing some "stones" which proved to be empty within. This matter has been discussed by Sagot (Bull. Soc. Bot. de France, vol. 33, pp. 317-326, 1886).

Of great interest is the number and character of the varieties, few of which were producing fruit during my stay in Tahiti. I asked many questions but received definite information only from Manu'a, a grower of Fe'i, and from J. Frank Stimson of Papeete, Polynesian scholar of the highest authority, who obtained accurate information from two native sources. I append the information thus gathered

as a contribution towards a better knowledge of Fe'i, since the average Tahitian seems much confused concerning these matters and I find little that is reliable and definite placed on record. Mr. Stimson writes (March 14, 1924) as follows:

Varieties of Fe'i.

- 'A'ata fruit:—the longest of all fe'is; tip is pointed; like *rurera*, but larger. (10 to 12 or more inches long; 2.5-3" thick.)
tree:—Very large, tall.
cluster:—Very large; oblong; loosely placed; the heaviest of all fe'i.
Pointed cluster.
color:—Reddish, to dark reddish brown.
miscellaneous:—
- 'Afara fruit:—About 4" long; like *tati'a*, but smaller; fat; sweet taste.
tree:—Large.
cluster:—Extremely close-set; when cluster falls, fruit does not break off. Cone shaped.
color:—Reddish, to very dark red.
miscellaneous:—Both wild and cultivated.
- 'Aiuri fruit:—Large; pointed ends, rather short, but fat.
tree:—Large.
cluster:—Conical; somewhat loosely placed, broad at bottom, narrow at top.
color:—Orange-yellow, to orange-red in sun.
miscellaneous:—A mountain fe'i, not much cultivated.
- Ha'a fruit:—Short, fat.
tree:—Very short, low; trunk big and thick.
cluster:—Big, pyramidal, closely placed; short, heavy.
color:—
miscellaneous:—Cultivated.
- Mahani fruit:—Very large and long, but not so long as the 'a'ata.
tree:—
cluster:—Has a single, large fruit upright on the very tip of cluster.
miscellaneous:—
- Oeoe fruit:—Short, fat
tree:—
cluster:—Somewhat conical, large, closely placed.
color:—
miscellaneous:—
- Paru fruit:—Similar to 'aiuri.
tree:—Large.
cluster:—Not conical, but oblong; otherwise like 'aiuri; close-set; tip short, sterile.
color:—yellowish to orange-red.
miscellaneous:—Cultivated; also grows wild in mountain valleys.
- Poti'a fruit:—Very large, nearly round, but pointed; grows up to nearly or quite a foot in *longitudinal* diameter,—the size of a large bread-fruit.
tree:—Large.
cluster:—Two to three fruit, and never more than five; loosely placed.
color:—If growing in the sun, orange-reddish; if in the shade, orange-yellow.
miscellaneous:—Is both cultivated and wild.

- Rau'oro* fruit:—Similar to 'aiuri.
 tree:—
 cluster:—Contains one or more very large fruits much larger than the rest.
 color:—
 miscellaneous:—Informant has never seen this variety outside of the district of To'ahotu, where it is cultivated.
- Rureva* fruit:—Similar to 'a'ata, but smaller; rounded ends.
 tree:—Large.
 cluster:—Somewhat loosely placed.
 color:—Yellow to orange-yellow.
 miscellaneous:—Not cultivated.
- Tuti'a* fruit:—Medium sized; like 'afara, but larger, short and fat, but not as thick as those of *oeoe*.
 tree:—Large.
 cluster:—Close-set at base, gradually becoming loosely-set towards the top; tip long sterile, and recurved.
 color:—Red.
 miscellaneous:—Not cultivated.
- Turu'a no*
Ti'ahoro fruit:—Similar to *mahani*, very large.
 tree:—
 cluster:—Does not have the single, upright fruit on tip of cluster; otherwise very like *mahani*.
 miscellaneous:—Habitat is thought to be confined principally to Vahiria and the district of Mataiea.
- 'U'ururu* fruit:—Shaped like a breadfruit; similar to *poti'a*, but smaller.
 tree:—Small.
 cluster:—Pointed, and fairly large; up to 10 or more fruit.
 color:—Orange-red in the sun; orange-yellow in the shade.
 miscellaneous:—Not cultivated.

My informant thought these were all the varieties in Tahiti.

Later, on August 1, 1924, he adds the following:

Since my last letter to you I have had an opportunity to make further enquiries concerning the *fe'i*. The result will be found below. You will note that I do not repeat the information already sent but merely note such additional facts as have come to hand

- 'A'ala* fruit:—Tip is very pointed. Longer than *rureva*. Up to 10 or 12 inches or even more. 2.5 to 3 inches thick, sometimes even 3.5 inches thick.
 cluster:—Pointed.
 color:—Reddish to red-brown.
 miscellaneous:—Both cultivated and wild.
- 'Afara* fruit:—Fat: sweet taste.
 tree:—Medium-large.
 cluster:—Very long tip to cluster; cone-shaped.
 color:—Not red; this informant says it is yellow, sometimes shading into orange.
- 'Aiuri* fruit:—Rather short, but fat.
 tree:—Both large and small depending on quality of soil.
 cluster:—Broad at bottom; narrow at top.
 color:—Orange-yellow to orange-red in the sun.

- Ha'a* fruit:—Short, fat, pointed end; about 5 inches long.
cluster:—Cone-shaped; closely placed; short, heavy.
color:—Red to dark russet or brown-red.
- Mahani* tree:—Large.
color:—Orange-yellow.
miscellaneous:—Wild, not cultivated.
- Oeoe* fruit:—Not short, but long. Fat at base becoming sharply pointed at end.
tree:—Very large.
cluster:—somewhat conical; large; usually closely placed but sometimes looser.
miscellaneous:—Both cultivated and wild.
- Paru* miscellaneous:—Grows wild as well as under cultivation.
- Poti'a* miscellaneous:—This informant thinks is very rarely, if ever, cultivated.
- Rau'oro* Not known to this informant.
(NOTE:—This variety is evidently rare, and not one of those gathered for the Papeete market.)
- Rureva* color:—Said to be reddish, or orange-red rather than yellow.
miscellaneous:—Occasionally cultivated.
- Tati'a* fruit:—Not medium-sized, rather short and fat, not, however, as thick as the *oeoe*.
tree:—Medium-large.
- Turu'a no Ti'ahoro* (literally: 'The pillow of Ti'ahoro').
tree:—Large.
color:—Orange-yellow.
- 'U'ururu* tree:—Usually medium-sized rather than small; occasionally grow quite large.

Manu'a, a Tahitian in Papeari who grew Fe'i in a valley and who seemed well acquainted with them, supplied sample bunches of those fruiting on his place about the middle of July and gave information as to the different varieties with which he was acquainted. I transcribe the following notes:

- 'A'ata* Fruits long, dark, reddish-brown and loosely placed in the cluster.
- 'Afara* Fruits small, short, fat, cone-shaped, very dark red, placed closely in a fat cone-shaped bunch.
- 'Anuri* Fruits of ordinary size, short and fat, red, loosely placed in a large cluster, which is broad at the base and narrow at the top.
- Ha'a* Fruits short, fat, closely placed in short, round, heavy clusters borne on low plants not over 6 feet high.
- Oeoe* Fruits short, fat, red, placed very close together in large clusters.
- Paru* Fruits very similar to those of *Tatia*, but more round.
- Poti'a* Fruits very large, up to 1 foot or more in diameter, from 10 to 15 fruits in a bunch.
- Rureva* A Fe'i of Paea is said to have "stones" in September, but Manu'a did not have it on his plantation.
- Tatia* Fruits large, but short and fat, although not so much so as those of *Oeoe*, close together in large oblong clusters, with a sterile recurved red tip.
- 'U'ururu* A "wild" Fe'i with fruits shaped like those of *'Uru*, breadfruit, in pointed and fair-sized bunches.

Manu'a told me that the best seasons for Fe'i are in December and January and again in February and March, although some fruit is to be obtained at all times. Stones are seasonal in appearance and *Oeoe* and 'Aiuri have the larger quantity.

Musa sapientum L.

Bananas are cultivated in several varieties. Plantains (*Musa paradisiaca* L.) may also be cultivated but I had no opportunity of making any careful study of either.

ZINGIBERACEAE

Languas speciosa (Wendl.) Merrill

261. Roadsides, in tall dense clumps, near Papenu, June 4 (in flower). Cultivated and established; native of southeastern Asia, more commonly known as *Alpinia speciosa* Wendl.

The Tahitians commonly call it "*Opuhi*," a name also applied to other members of the family.

Amomum Cevuga Seem.

420. Lower Maara Valley, abundant, June 22 (in flower). Indigenous; originally described from Fiji. The Tahitian name is "*Opuhi*," but Nadeaud gives "*Avapuhi*."

Curcuma longa L.

218. Frequent, at various altitudes, Fautaua Valley, May 31 (without flowers or fruits). Indigenous or early introduced; originally from India. This plant is the source of the "turmeric" for curries as well as the chemical indicator "turmeric."

CANNACEAE

Canna indica L.

239. Along roadsides, common, District of Papeari, June 2 (in flower). Escaped from cultivation; pantropic, a native of tropical America. Cultivated species with larger, more showy and variegated flowers are seen, but were neither collected nor studied.

ORCHIDACEAE

For the determinations of the members of this family I have to thank Dr. R. Schlechter of Berlin.

***Vanilla pompona* Schiede?**

260. Escaped(?) from cultivation, near Papenu, June 4 (young pods only). 306. Lower part of Orofere Valley, June 8 (young pods only). Cultivated; originally from Mexico. The lack of flowers renders the determination provisional. Pancher (cf. Cuzent, 1860, p. 239) states that *V. aromatica* Sw. was introduced by Admiral Hamelin in 1846 and *V. planifolia* Aud., by Rear Admiral Bonard in 1850.

***Oberonia glandulosa* Lindl.**

308. On trees, scanty, Orofere Valley, Paea District, June 8 (neither flowers nor fruit). 430. On tree trunk, in deep shade, Maara Valley, June 22 (in flower). Endemic to the Society Islands.

***Liparis clypeolum* Lindl.**

541. In soil at 2500 ft. altitude, upper Fautaua Valley, July 8 (in fruit). Indigenous. Samoa.

***Microstylis resupinata* (Forst.) Drake**

206. On shaded rocks, middle Fautaua Valley, May 31 (in young fruit); on shaded cliffs, Fautaua Valley, June 3 (in flower). 293. In ground, under trees, along Papehue River, District of Paea, June 7 (in ripe fruit). 309. Orofere Valley, June 8 (in flower). 438. On rocks, at low altitudes, Maara Valley, June 22 (in young fruit). 513. Fautaua Valley, at 2000 ft. altitude, July 7 (in flower). Endemic.

***Phaius tahitensis* Schlechter nom. nov.**

Calanthe grandiflora Nadeaud, Enum., p. 37, No. 271, 1873.

423. In earth on steep bank, Maara Valley, District of Papeari, June 22 (in flower).

***Calanthe gracillima* Lindl.**

314. Moist river bed, at medium altitude, Orofere Valley, District of Paea, June 8 (in fruit). 421. In earth of steep, deeply shaded bank, Maara Valley, at low altitude, District of Papeari, June 22 (in flower). Endemic.

***Dendrobium biflorum* Sw.**

310. On trees, 2000–2500 ft. altitude, Orofere Valley, District of Paea, June 8 (in flower). 456. On trees by roadside, near sea level, District of Afaahita, June 23 (in flower and fruit). 517. On trees, over 2000 ft. altitude, near "The Diadem," July 7 (in flower and fruit). Indigenous; originally described from Tahiti, Fiji, and Samoa.

***Dendrobium involutum* Lindl.**

431. On trees, low altitudes, Maara Valley, June 22 (without flowers or fruit). Endemic.

***Dendrobium crispatum* Sw.**

453. Frequent on trees, roadsides in District of Afaahita, near sea level, June 22 (in flower). Endemic.

***Eria Setchellii* Schlechter sp. nov.**

516. Flowers cream color; on trees at about 2000 ft. altitude, Fautaua Valley, opposite "The Diadem," July 7 (in flower and fruit). Endemic.

This is the *Eria Viellardi* of Drake del Castillo (Ill. Fl. Ins. Mar. Pac., fasc. 5, pl. 49, 1889, and Fl. Polyn. Franc., 1893, p. 242) but not of Reichenbach fil. (Linnaea, vol. 41, p. 86, 1877) which is confined to New Caledonia.

***Phreatia Matthewsii* Reichenb. f.**

515. On trunk of *Fagraea Berteriana*, crest of knife-like ridge opposite "The Diadem," about 1900 ft. altitude, July 7 (in flower). 534. Upper Fautaua Valley, not far from last, also on *Fagraea Berteriana*, 2500 ft. altitude, June 8 (in flower). Endemic.

The flowers are white and remarkably and pleasingly fragrant.

Phreatia tahitensis Lindl.

221. On trees, frequent, Fautaua Valley, at moderate altitudes, May 31 (scattering and early anthesis). 313. On trees along river bank, Orofere Valley, District of Paea, June 8 (in flower). Endemic.

Schlechter notes that No. 247, collected on a tree up the Fautaua Valley on June 3, in fruit, but unfortunately without flowers, is the *Cirrhopetalum Thouarsii* of Drake del Castillo (Fl. Polyn. Franc., p. 211, 1893) but is not the true *C. Thouarsii* Lindl. of Madagascar.

PIPERACEAE

Piper methysticum Forster

467. Edge of cultivated field, Tautira, June 23 (in flower). Cultivated from early times; Polynesian. The Tahitian names are "'Ava" and "Hoi," the latter probably from likeness to *Dioscorea bulbifera*.

Piper excelsum Forster

212. Occasional in moist shaded places along trail, middle of Fautaua Valley, May 31 (without flowers or fruit). 340. On edge of high cliff, Orofere Valley, District of Paea, May 31 (with flowers). Indigenous; originally described from New Zealand. The Tahitian plant is var. *tahitianum* C. DC. and may be found to be specifically distinct. No. 212 was called "'Ehoi" by the natives present at the time of collection.

Piper latifolium Forster

274. On moist bank, along roadside, District of Tiarei, June 5 (without flowers or fruit). Endemic. The Tahitian name is "'Ava turatura."

Piper tristachyon C. DC.

341. In thick bush, head of Orofere Valley, District of Paea, June 13 (in flower). Endemic. Nadeaud (1873, p. 41) suggests that this is a pubescent form of the preceding.

Peperomia

Three species have been described with Tahiti as the type locality, viz.: *Peperomia pallida* (Forst.) A. Dietr., *P. Moerenhoutii* C. DC., and *P. Hombroni* C. DC. Casimir De Candolle in the *Prodromus* (vol. 16:1) credits also the widespread *Peperomia reflexa* (L. fil.) A. Dietr. and the Australio-Polynesian *P. leptostachya* to Tahiti. Both of these latter species are of the group with verticillate leaves, of which we encountered no examples in our collecting. I have distributed the plants collected by us among the three species already described from Tahiti, in spite of certain differences between them and the descriptions.

***Peperomia Moerenhoutii* C. DC.**

Plate 31

23. In crevices of shaded rocks, near Fort Faa Rahi, Fautaua Valley, May 21 (in flower). Endemic to Tahiti.

I am referring here a plant from the information contained in Casimir De Candolle's key (Candollea, vol. 1). It has opposite leaves, occasionally whorled above. Both leaves and stem are sparingly pubescent, but the rhachis is glabrous. The leaves are moderate in size, the upper being elliptical lanceolate, acute below, aentish above, the blades 2.5–3 cm. long by 1.4–2.2 cm. broad, averaging 1.5 to 2 cm. wide, sparingly hairy on both surfaces, and 5-nerved. The petioles are 0.3–1 cm. long. The lower leaves and those on young shoots are, however, orbicular-spatulate. The spikes are axillary, about three times as long as the leaves, slender and loosely flowered, up to 11 cm. long, with peduncle (very sparingly hairy) 1–2 cm. long. The stigma is oblique.

Var. *macrophylla* var. nov.

Plate 32

Speciei typicae in characteribus caulis primariae, foliorum inferiorum, etc., similis, sed in foliis ramorum elongatis, 5–6 × 1.5–2 cm. differens. (Type Herb. Univ. Calif., No. 219837).

289. On trees and rocks, Papahue Valley, Paia District, June 7 (in flower).

The plants referred here have the primary stem and its leaves closely resembling those of No. 23, but the leaves of the branches are elongate, giving a dimorphic appearance to the plant, which is striking. A similar diversity between cauline and branch leaves is found in *P. Pringlei* C. DC. The branches and their leaves are only very slightly hairy. The spikes are 14–15 cm. long, very slender and lax-flowered as in the species.

Var. *subglabra* var. nov.

Plate 33

Speciei typicae approximans, sed minus pubescens et spicis brevioribus, longitudinem foliorum aequantibus aut dimidio superantibus differens. (Type Herb. Univ. Calif., No. 219964.)

182. On dripping rocks, Maraa Caves, May 29 (in flower and fruit).

The plants I refer here have only scant hairiness of stem and petiole, extending only slightly beyond the leaf bases. The spikes are short for the species but may be longer in older specimens. It seems best to group them with No. 23.

***Peperomia Hombronii* C. DC.**

Plate 34

540. In small clusters, pendent from trees, upper Fautaua Valley, at about 2500 ft. altitude (in anthesis). Endemic.

This small-leaved species was very fragrant, especially on drying, with an odor like that of the “*Ava*.” It seems to answer the requirements of C. De Candolle’s “key” for this species. The leaves are alternate, thick three-nerved elliptical-lanceolate to lanceolate, acute at the base, 1.5–2.5 cm. long by 1–1.2 cm. broad (usually broadest at or about the middle), with short petiole (2–3 mm. long). The whole plant is glabrous, the stems are creeping, becoming somewhat pendent in the upper portions of the branches. The young spikes are up to 6 cm., with peduncles about 1 cm. long, both peduncles and rhachis (in anthesis) glabrous and close flowered. The ovary is obtuse at the very apex, with a small lateral obtuse, sessile, capitate stigma. The bracts are small, peltate-turbinate (in anthesis).

***Peperomia pallida* (Forst.) A. Dietr. var. *acuminata* var. nov.**

Plate 35

Speciei typicae similis, sed foliis, praecipue superis, conspicue acuminatis. (Type Herb. Univ. Calif., No. 219839.)

252. On soil among rocks, Fautaua Valley, June 3 (in flower). Polynesian, the species originally described from Tahiti.

The plants referred here answer to the descriptions of C. De Candolle (Prodromus, vol. 16:1, p. 418) and to the characters of his later key (Candollea, vol. 1). The leaves are alternate, rhomboid-elliptical, long acute below and at the tips, glabrous on both sides with glabrous petiole. The blade of the leaf is 2–6 cm. long by 0.8–2.5 cm. wide in well developed leaves, with petioles 0.3–1 cm., ordinarily about 0.5 cm. long. The lowest cauline leaves are smaller, broadly rhomboid-elliptical to orbicular-spatulate. None is punctate. The stems are creeping, later erect, and entirely glabrous. The spikes are slender, 5–6 cm. long, barely if at all extending beyond the leaves, with peduncles 1–2 cm. long, glabrous throughout, densely flowered; bracts peltate; ovary obliquely stigmatic, stigma near the apex, sessile fimbriate. The leaves of our plants approach in shape the descriptions of those of *P. Endlicherii* C. DC., but their size, length of spike, etc., answer more closely to the description of *P. pallida*. The following variety answers more nearly to the description of *P. pallida*, but in size of leaf, length of spike relative to the leaves, etc., it seems to come nearer to *P. Endlicherii* C. DC.

***Peperomia pallida* var. *longespicata* var. nov.**

Plate 36

Caulibus succulentis, repentibus et pendentibus, glabris; foliis alternis, utrinque glabris, ellipticis aut obovato-rhomboides, usque ad obovatis, basi longe attenuatis acutisque, supero plus minusve angustatis obtusiusculisque, multivenosis, 2–2.5 cm. longis et 1.5–2 cm. latis, petiolis 5 mm. longis, venis primariis 5, 3 mediis robustioribus; spicis solitariis axillariis terminalibusque, gracilibus densifloris, usque ad 4.5 cm. longis, pedunculis 2 cm. longis; bracteis parvis, delicatis, peltatis, liberis; ovariis stigmatibus capitatis oblique instructis. (Type Herb. Univ. Calif., No. 219833.)

Pendent from trunks of trees. 502. Above the falls, Maara Valley, June 29 (in flower). 499. Below the falls, Maara Valley, June 29 (in flower). 433. Towards lower end of Maara Valley, June 22 (in flower).

I have selected No. 502 (Herb. Univ. Calif., No. 219833) as the type of this variety from the Maara Valley in the Papeari District, since it seems better developed than either of the other two collections from the same valley. It seems best to associate these plants with *Peperomia pallida*, from descriptions of which they differ chiefly in leaf-size and relative length of spike. The leaves are nearer the proper shape for *P. pallida*, but are only about half the size required by the description, while the spikes are between two and three times the length of the leaves instead of being shorter than the leaves as required by the description of *P. pallida*. In these characters, our plants agree better with the description of *Peperomia Endlicherii* C. DC. (from Norfolk Island), but the leaves are not at all acute at the tips. In leaf shape and size, as well as in relative length of spike, the Maara Valley plants are very different from the Fautaua plant, we are placing under *P. pallida* var. *acuminata*.

MORACEAE

Morus multicaulis Perr.

209. Low, slender tree, Fautaua Valley, upper road to fort, May 31 (with scanty fruit). Introduced; originally described from China. Pancher (cf. Cuzent, 1860, p. 239) states that it was introduced in 1850 by Admiral Bonard.

Artocarpus communis Forster

365. Cultivated, Papeete, June 16 (in flower and fruit). 409. Roadside, District of Faaa, June 21 (without flowers or fruit); "*Uruvai*." 509. Cultivated, District of Faaa, July 5 (with fruit). Introduced early or indigenous(?). No seed-bearing trees are known. A number of varieties of shape of leaf and shape, size, color, and flavor of fruit are found. The earlier name is "*Uru*," the later "*Maiores*," according to Nadeaud.

Artocarpus integra (Thunb.) Merrill

398. Cultivated, Experimental Garden, Papeete, June 19 (in fruit). Introduced; native of tropical Asia. The "*jak fruit*" is little known in Tahiti. It is more commonly known as *Artocarpus integrifolia* L. f.

Ficus tinctoria Forster

176. On high, dry cliff, Maraa Point, May 27 (with red fruits). Indigenous; originally described from the Society Islands. Commonly called "*Mati*."

Ficus prolixa Forster

78. Coastal plain, among native dwellings, Punaruu Valley, District of Punaauia, May 23 (in fruit). Indigenous; originally described from the Society Islands. Reported from the Marquesas Islands and from New Caledonia.

ULMACEAE

Celtis paniculata Pl.

339. Shrub, on cliff about 2000 ft. altitude, Orofere Valley, June 8 (without flowers or fruits). Indigenous; southern Polynesia.

URTICACEAE

Elatostema pedunculatum J. R. and G. Forst.

244. On trees, Fautaua Valley, June 3 (with heads of orange fruit). 465?. On trees near roadside, between Maara and Tautira, June 23 (with red heads of fruits). Indigenous; originally described from the Society Islands.

Since, as will be explained under *Langeveldia*, the following genus, *Elatostema* was definitely founded on *E. pedunculatum*, it seems necessary to use the foregoing binomial rather than the more familiar *Procris pedunculata* (Forst.) Wedd.

Langeveldia sessilis (J. R. and G. Forst.) comb. nov.

Elatostema sessile J. R. and G. Forster, Char. Gen., p. 106. 1776; *Dorstenia pubescens* G. Forster, Flor. Ins. Austr. Prod., p. 11, 1786.

170. On dripping rocks, main cave at Maraa, District of Paea, May 27 (with flowers and fruits). 181. Same locality, May 29 (with flowers and fruits). 419. On dripping mossy banks, Maara Valley, District of Papeari, June 22 (with flowers). 426. Same locality, different spot, June 27 (with flowers). 522. On dripping rocks at about 2000 ft. altitude, Fautaua Valley, July 7 (with flowers).

In explanation of the new combination proposed above, reference may be made to the remarks of C. B. Robinson (Phil. Jour. Sci., sec. C. Bot., vol. 5, p. 508, 1911), wherein a very satisfactory discussion of the status of *Elatostema* and *Procris* is to be found. He states, most correctly, that "the figures of the staminate flower show it to be pentamerous," i.e., as belonging to *E. pedunculatum* Forst. (*Procris pedunculata* (Forst.) Wedd.). He says, however, "the figure of the flowering pistillate receptacle is perhaps better for *Elatostema*, that of the fruiting is surely taken from *Procris*." We learn from Guillemain (Ann. Sci. Nat., ser. 2, Bot., vol. 7, p. 183, 1837) that the Forsters had only the staminate plant of *Elatostema sessile*, so that their figures must have been drawn entirely from their *Elatostema pedunculatum* and consequently we are compelled to accept that species as the type of the genus. If the large group of described species now commonly included under *Elatostema* are to be kept distinct from those represented by *E. pedunculatum* and now commonly included under *Procris*, they are to be referred under *Langevelandia*, the genus instituted by Gaudichaud (Bot., Freycinet's Voyage, p. 494, 1826). This, unfortunately, involves changes of name for the many species referred to *Elatostema* as well as for a few referred to the genus *Procris*. It seems best, however, not to undertake to make changes here other than of the immediate species concerned in this account, since I am in no position to form a critical estimate of the species referred under the one genus or the other. A study of the Tahitian numbers of the genus *Langevelandia* particularly interests us, since the earliest described species of the genus came from the Society Islands and presumably from Tahiti itself. Concerning *Langevelandia sessilis*, we have the transcript of Forster's notes by Guillemain (Ann. Sci. Nat., ser. 2, Bot., vol. 7, p. 183, 1837) and the reproduction of a photograph of the type specimen at the British Museum of Natural History by Robinson (Phil. Jour. Sci., vol. 6, Bot., pl. 2, April, 1911).

The type of the Forsters was evidently about 30 cm. high, with glabrous, unisulcate, simple stem, not very fleshy, with alternate, very nearly sessile, brownish green leaves, which were obliquely elliptical ovate, one-half being shorter and narrower, the other larger and subcordate, and with a distinct acumen at the tip. The leaves were serrate and 10–15 cm. long by 5–7 cm. broad. The staminate receptacles were axillary, raised on terete but very short peduncles, were large and expanded, depressed orbicular and clothed with sessile green ovate and very short squamules (bracts and bracteoles), distinct from

the pedicels of the flowers. The pedicels were unifloreate, terete, and about the length of the "paleae" (bracteoles). The corolla of the staminate flowers was 4-partite, the segments being slightly longer than the pedicel, ovate, acuminate, patent, and whitish. The stamens were four.

In our trips, specimens of *Langeveldia* were found in three distinct localities, viz., two collections at the Maraa Caves in the District of Paea, from two different portions of the lower Maara Valley in the District of Papeari, and one in the upper Fautaua Valley, facing the "Diadem." The elevation of each of the first and second localities was not over 50 feet above sea level, but that of the third was approximately 2000 feet. The plants all present general resemblances so that it seems best, for the present at least, to regard them all as belonging to the same species, at least in the broader sense, but they also show differences which it may be well to mention, since from the point of view of species in the narrower sense they may be considered of significance.

While it is possible to divide the specimens collected by us in Tahiti under five separate species, if we take minute criteria, even such as are given in different accounts of the species of the genus, yet the general resemblances are so close as to lead me to refer them all to one species, but a species in the broadest sense, at least for this genus. The plants have in common an herbaceous and at most only moderately stout stem, glabrous throughout or only slightly scabrous in the uppermost portions. The leaves are alternate, reduced below, but of fair size to large above and of fairly uniform shape, glabrous, but with closely placed elongated cystoliths on the upper surface and varying from glabrous to strigose along the veins, finally to sparsely but distinctly strigose over the lower surface. The plants vary from distinctly monoecious to apparently dioecious, but this character varies in the plants of the same collection. The tip of the leaf varies somewhat in the length of the acumen, but in none is it either absent or very long. Cystoliths of the elongated type, closely placed over the upper surface, are found only along the veins of the lower side of the leaf, being more conspicuous in some plants and less so in others. The teeth of the leaves are coarse in all the specimens and occupy the greater portion of the margin (up to all except a very small interval towards the base on each side) and vary in number according to the size of the leaf. The leaves are more or less obscurely triplinerved but in no case distinctly pinnately nerved. The number of nerves varies according to the size of the leaf, except

in the plants of No. 522, which are few-nerved proportionately to their size. The peduncles of the staminate receptacles vary even on the same plants from about 1 mm. to 15 mm., while the pistillate receptacles are all practically sessile. The outer bracts vary somewhat, but this is true to some extent at least of those of different receptacles in the same plant. They are all very slightly cornute. The bracteoles of both staminate and pistillate receptacles vary from broad and glabrous in numbers 170 and 181 (from the same bank) to broad and sparsely ciliate-strigose in numbers 419 and 426 (from the same valley) to narrow and thickly ciliate in No. 522 (from 2000 feet elevation). The divisions of the perianth of the pistillate flower are 4, well developed and linear in Nos. 170 and 181, but in Nos. 419, 426, and 522, reduced to brown, branched, hair-like structures at the tip of the pedicel. In the last three numbers the aborted stamens are more conspicuous than in the pistillate flowers of numbers 170 and 181. The variation in the perianth and staminal rudiments of the pistillate flowers is the most decided character I have found in our specimens, but since this is associated with an increase in strigosity in the plant, I suspect that it may also be a variable character. I lack the abundant material desirable for testing this suspicion. The achenia are of varying degrees of maturity in the different numbers, most of them seeming unripe, so that no inference may be drawn from their variation in shape, size, and markings.

The characteristic differences of our three groups of Tahitian plants may be outlined as follows:

A. var. (?) **maraaensis** var. nov. ad interim.

Plates 24, 25

170. Entirely glabrous even to bracts and bracteoles; stipules broad, with a single longitudinal nerve; perianth of pistillate flower well developed with four linear segments and rudimentary stamens barely, if at all, discernible. Maraa Caves, May 27.

181. Entirely glabrous, even to bracts and bracteoles; stipules unequally ovate lanceolate, with two longitudinal nerves; perianth of pistillate flower well developed, with four linear segments and rudimentary stamens barely discernible. Maraa Caves, May 29.

B. var. (?) Forsteri var. nov. ad interim.

Plates 26, 27

419. Strigose on the uppermost portions and on the peduncles, bracts, bracteoles, and the veins of the lower surface of the leaves; stipules narrowly ovate lanceolate, with two longitudinal nerves; perianth of the pistillate flower reduced to brownish pinnately branched hairs, rudimentary stamens conspicuous.

426. Same as 419, but leaves larger (up to 17 cm. long) with more lateral nerves, stipules long and narrow, with a single longitudinal nerve, bracts more unequal (two long and narrow, four short and inconspicuous), segments of perianth and aborted stamens as in No. 419. Both numbers in Maara Valley, June 22.

C. var. (?) fautauensis var. nov. ad interim.

Plate 28

Only pistillate plants seen; stems more or less sparsely strigose, increasing above; leaves thickly strigose below; stipules ovate with one or with two longitudinal nerves; bracts nearly equal, strigose as are also the narrow bracteoles; perianth of the pistillate flower reduced to irregular brown hair-like structures; aborted stamens inconspicuous.

552. On dripping rocks at about 2000 ft. altitude, Fautaua Valley, July 7 (with pistillate flowers).

Boehmeria platyphylla var. *virgata* Wedd.

Slender tree with flowers in ample panicles. 213. Frequent at about 1500 ft. altitude, Fautaua Valley, May 31. 250. Fautaua Valley, June 3. 490. Maara Valley, June 29. 531. On knife-like ridge in bed of creek between east and west forks of the Fautaua River at about 2200 ft. altitude, July 8.

LORANTHACEAE

Viscum articulatum Burm. f. (*in sensu latissimo*)

338. On trees on high cliffs, upper Orofere Valley, District of Paea, June 13 (in fruit). 497. On *Neonuclea Forsteri* (Seem.) Merr. and on other forest trees, above the falls, Maara Valley, June 29 (in fruit). Indigenous; originally described from the East Indies.

Van Tieghem (Bull. Soc. Bot. de France, vol. 43, pp. 169, 170, 1896) has distinguished four Tahitian species of his genus *Bifaria*. The plants of both our collections have joints five to six times as long as broad and attenuated towards the base, thus corresponding to Van Tieghem's *Bifaria Lepini*, so far as his descriptions indicate. The joints are 1-5 nerved, according to position on the plant. The fruits are very small, 1 mm. broad by 2 mm. long.

BALANOPHORACEAE

Balanophora pallens (Solander) comb. nov.

Plates 29, 30

Acroblastum pallens Solander, in Seemann, Fl. Vit., p. 100, 1866.

189. Parasitic on roots of *Hibiscus tiliaceus*, Fantaua Valley, May 31 (in flower).

This parasitic plant was found in shaded rich soil, always on roots of the *Hibiscus tiliaceus* and usually plentiful in its habitat, not only in the Fantaua Valley near Papeete but also in the Papehue and Orofere valleys in the District of Paea. Unfortunately, little material of what was collected was finally prepared and forwarded but there is sufficient to indicate clearly its structure and relationships. The plants form irregular rhizomes, 10 to 15 cm. long and a few centimeters in width. The surface of the rhizome is irregular and finely papillose. The color is yellowish white. The flowering stems emerge from a conical-ovoid swelling, through a splitting of the outer covering into two lobes or flaps, and are up to 12 cm. or more high and 0.5-1 cm. thick. As the stem elongates it ruptures unilaterally one after another conical covering which form the "leaves," in all about six of these

"leaves" are found, and the splitting proceeds successively in such a fashion as to leave them imbricate and spirally arranged. Above the uppermost leaf is a peduncular structure about 2 cm. long, on the upper part of which are scattered the staminate flowers, each with its 4-lobed perianth and a columnar or almost hemispherical staminoid structure, capped by somewhere about 20 short anthers. Above these is the elongated ellipsoidal pistilliferous portion or capitulum about 3-4 cm. long and 1.5-2 cm. thick. The capitula are thickly covered by the "*corpuscula brevissime pedicellata obovata*" of Solander's description. These "*corpuscula*" are properly gynophore branchlets or spadicels, each swollen above and bearing the simple pistils along their sides or condensed at their lower ends. In our species the pistils are clustered at the base of the spadicels. The corpuscula are about 1 mm. high, taper from a slender base, gradually to about two thirds their height, then suddenly swell out into a balloon-like upper portion, broadest at the broadly rounded, even almost flat top, where the diameter is 0.3 mm. The color is reddish-brown. The outer cells are large, giving the reticulate appearance described by Solander, and each of the top cells is swollen, at times very pronouncedly, and their outer walls are roughly granulated.

The type was collected in Tahiti on Cook's first voyage, somewhere between April 13 and July 12, 1769. What is probably the same species was included in Pancher's list (cf. Cuzent, 1860, p. 237) under *Balanophora fungosa* and the same name is used by Nadeaud (1873, p. 36), who possibly made the collection recorded by Pancher. Drake del Castillo (1893, p. 174) cites only the collection of Nadeaud.

The plant collected by us is very different from *Balanophora fungosa* Forster, whether we take the fragmentary description and figures of the type from Tanna in the New Hebrides Group (cf. J. R. and G. Forster, Char. Gen., pp. 99, 100, pl. 50, 1776, and G. Forster, Prodromus, p. 64, 1786) or the complete discussion of J. D. Hooker (Trans. Linn. Soc., vol. 22, pp. 30, 46, 47, pl. 8, 1856), the latter, however, possibly drawn largely from the Australian rather than from the type specimen and possibly not true *B. fungosa*. Hooker states that "all the specimens I have examined have bisexual capitula with the female flowers at the base," whereas his figure 1 on plate 8 shows the reverse condition, i.e., with the staminate flowers at the base.

Burkill (Jour. Straits Branch Roy. Asiatic Soc., No. 45, p. 219, 1905) mentions *Balanophora Hildebrandti* Reichenb. f. as occurring

not only on Comoro Islands (the type locality) but also on Tahiti. While Reichenbach's description (Jour. Bot., vol. 14, p. 45, 1876) is brief, it appears to apply to a more slender (although possibly closely related plant) than ours. Our plant is related to *B. insularis* Burkill (*loc. cit.*, p. 218) of Christmas Island but that is decidedly more slender with fewer "thecae" in the staminal column.

The structure of the staminal column in our flowers approaches that of Van Tieghem's genus *Polyplethia* (Ann. Sci. Nat., ser. 9, vol. 6, p. 193, 1907) or section of the genus as instituted by Griffiths (Trans. Linn. Soc., vol. 20, p. 94, 1846) except that the flower is not laterally compressed. If Van Tieghem's idea for segregation is to be adopted, Solander's genus *Acroblastum* as published by Seemann in the Flora Vitiensis (p. 100) is to be adopted and may include (either as synonym or as subgenus) the *Polyplethia* of Griffiths and of Van Tieghem. Solander gives the Tahitian name as "*Ea-owa*" and Nadeaud as "*Huamati*," his specimens being parasitic on the roots of *Ficus prolixa* and *F. tinctoria* (the latter called "*Mati*"). "*Hua*" refers usually to the male glands of animals.

POLYGONACEAE

Polygonum glabrum Willd.

128. In shallow, quiet water, roadside, near Tapahi, District of Mahina, May 25 (in flower). Indigenous; originally described from the East Indies but in extended sense pantropic and generally subtropic as well. The Tahitian names are "*Tamore*" and "*Pitorea*."

Corculum leptopus (H. and A.) Stuntz

112. Commonly cultivated and occasional escape, roadside over Tahara Mountain, District of Mahina, May 25 (with flowers). A native of tropical America, originally described from Mexico as *Antigonon leptopus* H. and A.

AMARANTACEAE

Achyranthes aspera L.

300. High up along the Papehue River, District of Paea, June 7 (in fruit). 320. Wayside weed, District of Tiarei, June 9 (in fruit). Probably introduced early; pantropic weed, originally described from Sicily, Ceylon, and Jamaica. The native name is "'*Aerofai*," because of the resemblance in the native's mind to the tail of the sting-ray.

Gomphrena globosa L.

In gardens as an ornamental; Papeete. Cultivated in all warm countries.

NYCTAGINACEAE

Pisonia umbellifera (Forst.) Seemann

196. High up the Fautau Valley, May 31 (with flowers). 437. Small tree, Maara Valley, June 22 (with flowers). 492. Small tree, above the falls in Maara Valley, District of Papeari, June 29 (in young fruit). 527, 528. Small trees at about 2500 ft. altitude, ridge between east and west forks of the Fautau River, July 8 (with flowers). Indigenous; originally described from Tanna Island, New Hebrides. The Tahitian name is "*Puatea*."

Pisonia grandis R. Br.?

451. Much planted for living fence posts, especially in the District of Afaahiti, June 23 (without flowers or fruits). It is possibly introduced from the Tuamotu Archipelago and is used because posts cut from it and placed in the ground take root readily and grow.

Bougainvillea spectabilis Willd.

479. Cultivated as ornamental, Maara, District of Papeari. Common in cultivation.

PORTULACACEAE

Talinum patens Willd.

72. On rocks among trees, lower end of Punaruu Valley, District of Punaauia, May 25 (in fruit). Probably introduced early; a native of tropical America. Nadeaud says (1873, p. 66) that the Tahitians call it "*Aturi*," but he seems to have confused it with the next species, as did also Drake del Castillo (1893, p. 9).

Portulaca lutea Forster

91. Base of cliffs, Tapahi, District of Mahina, May 23 (with flowers and fruits). 135. Same locality, May 25. 330. Same locality (seeds). Indigenous; tropical Polynesia. The type locality is on the Island of Huahine. This is the true "*Aturi*" of the Tahitians.

I have discussed the morphology of this species in my "Vegetation of Tutuila Island" (Carnegie Inst. Wash., Publ. No. 341, pp. 250, 251, pl. 34, fig. C, pl. 35, fig. A, fig. 54, figs. 1-10, 1924).

Portulaca oleracea L.

151. Weed in vegetable garden at Outo-maoro, May 26 (with flowers and fruit). Introduced early; probably a native of southern Europe.

ANONACEAE

***Canangium odoratum** (Lam.) Baill.

223. Large tree near a native house, District of Faaa, June 1 (with flowers and fruit). Introduced from East Indies into Polynesia. The Tahitian name is "*Moto'oi*." It is not given for Tahiti by Pancher, Nadeaud, or Drake del Castillo. It was probably early cultivated.

Anona reticulata L.

339. Small tree, Experimental Grounds, Papeete, June 19 (with unripe fruits). Cultivated; originally from tropical America.

Anona squamosa L.

362. Small tree, near road, at Punaruu River, District of Puna-
aia, June 14 (with overripe fruits). Cultivated; originally from
tropical America.

Pancher (in Cuzent, 1860, p. 227) states that *Anona muricata* L.
was introduced by Ellis, the English missionary, in 1817, and *A.*
cherimolia Mill. in 1846 by Admiral Le Goarant.

LAURACEAE

Cassytha filiformis L.

123. Abundant along the road over Tahara Mountain, May 25
(with flowers and fruit). Indigenous; pantropic; originally described
from "India."

Persea americana Mill.

484. Trees by roadside, near Punaruu Bridge, District of Puna-
aia, June 26 (in flower). Commonly cultivated; originally from
tropical America, generally known as *Persea gratissima* Gaertn.

Cinnamomum Camphora T. Nees and Eberm.

395. Experimental Gardens, Papeete, June 19 (without flowers
or fruits). Cultivated; originally from China.

HERNANDIACEAE

Hernandia ovigera L.

286. Large tree at edge of strand at Papatoai, Moorea, June 7
(with fruit). 462. In garden about native house, Tautira, June 23
(with flowers). Indigenous; one of the strand trees of the tropics,
well adapted to dissemination by flotation. On Moorea, it is still
frequent, although sought for its wood, but on Tahiti well grown
trees are now very scarce. The Tahitian name is "*Ti'a-nina*."

CAPPARIDACEAE

***Polanisia icosandra** (L.) W. and A.

164. Dry bank, by roadside, apparently scarce, District of Faava, May 27 (with flowers and fruits). Introduced; a pantropic weed, originally described from Ceylon, generally known as *Polanisia viscosa* DC.

MORINGACEAE

***Moringa oleifera** Lam.

470. Native garden, Urihore, District of Vairao, June 24 (with flowers). Introduced; pantropic in cultivation; originally from tropical Asia, often known as *Moringa pterygosperma* Gaertn.

CRASSULACEAE

***Bryophyllum pinnatum** (Lam.) Kurz.

71. Plentiful in shade, lower end of Punaruu Valley, District of Punaauia, May 23 (with flowers). Of fairly recent introduction; native of tropical continental Asia.

SAXIFRAGACEAE

Weinmannia parviflora Forster

527. Tree, ridge between east and west forks of the Fautaua River, about 2500 ft. altitude, July 8 (without flowers or fruits). Type from Tahiti; occurs also on the Marquesas. Our plant is of the form with simple leaves.

LEGUMINOSAE

Serianthes myriadenia Planchon

494. Slender sapling, above the falls, Maara Valley, June 29 (without flowers or fruit). Indigenous; originally described from Tahiti; also in Fiji and (without confirmation) from Samoa.

***Samanea Saman** (Jacq.) Merr.

372. Shade tree near Tiare Hotel, Papeete, June 16 (with scanty flowers). 349. Commonly planted as a shade tree along roads and in enclosures, Papeete, June 13 (with scanty flowers). Pantropic in cultivation; originally described from tropical America.

The large trees which are such a pleasing feature of the waterfront of Papeete and elsewhere are of this species. It is called "Monkey-Pod" and "Rain Tree" elsewhere but in Tahiti is popularly confused with the "Flamboyant," or *Poinciana regia* (*Delonix regia* (Boj.) Raf.), often mixed with it. The size of many of the trees indicates considerable age but I find no mention of the species in Pancher or other writers unless under names not recognized as applicable. It is more commonly known as *Pithecolobium saman* Benth. and *Enterolobium saman* Prain.

***Pithecolobium dulce** (Roxb.) Benth.

226. Sapling, District of Papeari, June 2 (without flowers or fruit). 417. Large tree, enclosure of house at Maara, District of Papeari, June 22 (with flowers and fruit). Planted sparingly; originally from tropical America.

Inga edulis Mart.

160. Roadsides, common in District of Faaa, May 27 (with flowers). Cultivated; originally from Brazil.

Albizzia Lebbek (L.) Benth.

153. Common roadside tree, District of Punaauia, near Punaruu Bridge, May 26 (with immature pods). Cultivated; a native of tropical Africa and Asia. Pancher (cf. Cuzent, 1860, p. 231) states that it was introduced by Johnstone in 1845.

Acacia Farnesiana (L.) Willd.

177. Roadside shrub, District of Faaa, May 29 (with flowers and fruits). Introduced and too well established; native of tropical America. Pancher states (cf. Cuzent, 1860, p. 231) that it was introduced by Johnstone in 1845.

Leucaena glauca (L.) Benth.

47. Roadsides, frequent in District of Faaa, May 22 (with flowers and fruits). Introduced and well established; native of tropical America. Pancher states (cf. Cuzent, 1860, p. 231, sub *Acacia leucocephala*) that it was introduced by Johnstone in 1845.

Mimosa pudica L.

60. Along roadsides, common in the District of Faaa, May 22 (with flowers and young fruits). An introduced weed, too well established; a native of tropical America. Pancher states (cf. Cuzent, 1860, p. 231) that it was introduced by Johnstone in 1845.

Adenanthera pavonina L.

251. Trees, abundant in lower forest of Fautaua Valley, June 3 (with fruits and ripe red seeds). Introduced; native of India. Pancher states (cf. Cuzent, 1860, p. 231) that it was introduced by Johnstone in 1845.

***Cynometra ramiflora** L.

393. Experimental Garden, Papeete, June 19 (with pods). Introduced; ranges from Ceylon to tropical Australia.

Tamarindus indica L.

134. Edge of field near Punaruu Bridge, District of Punaauia, May 26 (with fruit). Introduced; pantropic; probably a native of tropical Africa. Said by Pancher (cf. Cuzent, 1860, p. 231) to have been first planted at Haapape (Point Venus) by Cook's Expedition in 1769.

***Bauhinia monandra** Kurz.

449. Roadside tree, District of Papeari, June 23 (with flowers and young pods). Introduced; pantropic in cultivation; native of tropical America.

****Bauhinia variegata* L.**

155. Planted near Punaruu Bridge, District of Punaauia, May 26 (with ripe pods)? 548. In residential grounds, District of Papara, July 12 (with flowers). Introduced ornamental; native of East Indies.

Pancher (cf. Cuzent, 1860, p. 231) states that *B. tomentosa* was introduced by Johnstone in 1845. The Tahitians use the beans, mashed and steeped in water, for distress of the stomach.

****Cassia alata* L.**

231. Escaped from gardens, District of Papara, June 2 (with flowers). Introduced; native of tropical America.

***Cassia occidentalis* L.**

224. In a field, mouth of Fautaua Valley, June 1 (with flowers and pods). 447. Roadside at Maara, District of Papeari, June 25 (with flowers and young pods). Introduced; a native of tropical America, now pantropic. Pancher (cf. Cuzent, 1860, p. 231) states that it was introduced in 1825.

****Delonix regia* (Boj.) Raf.**

Frequently planted, this tree is the "Flamboyant" of the French inhabitants, although they often pointed to the more common "Rain Tree" or *Samanea saman*, a tree with comparatively insignificant display of flowers, as the "Flamboyant." It is a native of Madagascar but is pantropic in cultivation. Pancher, in 1860, does not mention this species as in cultivation in Tahiti. It is more commonly known as *Poinciana regia* Boj.

****Crotalaria Saltiana* Andr.**

40. Roadsides, District of Faava, May 22 (with flowers and pods). Introduced; pantropic; originally described from the tropics of the Old World.

***Crotalaria verrucosa* L.**

39. Roadsides, District of Faava, May 22 (with flowers and pods). Introduced; pantropic; originally described from India. Pancher notes it in 1860.

Crotalaria sericea Retz.

166. Erect, suffrutescent herb, waysides, District of Faaa, May 27 (with flowers and fruits). Introduced; pantropic. This may be *C. retusa* L., since some specimens referred to *C. retusa* have mucrones at the tip of the uninjured leaves, but *C. sericea* Retz. has distinctively a mucro. Our plant is fairly certainly the *C. sericea* of Drake del Castillo (1893, p. 41).

***Indigofera suffruticosa Mill.**

61. Wayside weed, District of Faaa, May 22 (with flowers and pods). Introduced; pantropic; probably of American origin. Pancher (cf. Cuzent, 1860, p. 230) states that *I. tinctoria* L. was introduced by the English missionaries.

***Aeschynomene indica L.**

101. Moist land, Ahonu Valley, District of Mahina, May 23 (with flowers and fruits). Introduced; inhabitant of tropics of the Old World.

***Desmodium triflorum (L.) DC.**

122. Roadsides, Tahara Mountain, May 25 (with flowers and pods). Introduced; pantropic; originally described from India; not mentioned by Pancher in 1860.

***Desmodium incanum (Sw.) DC.**

280. A single patch, roadside, west side of bridge over Papenu River, June 5 (with flowers and fruits). Introduced; native of tropical America.

Inocarpus edulis Forst.

99. Tree, shore region, Ahonu Valley, District of Mahina, May 23 (with flowers). Indigenous, Malaysia to Polynesia. In Tahiti this species, called "*Mape*," ascends the valleys to an elevation of a few hundred feet but is usually found in damp places on the coastal plain.

Clitoria ternatea L.

168. Low twining vine, waysides, common in the District of Faaa, May 27 (with flowers). Escape; pantropic in cultivation; originally described from India. Pancher (cf. Cuzent, 1860, p. 230) states that it was introduced in 1845 by Johnstone.

Canavalia microcarpa (DC.) Piper

158. Trailing vines under coconuts on seashore, District of Arue, May 27 (with flowers and pods). Indigenous, littoral, wave-borne species; India and Malaysia to Polynesia. This is probably the *C. obtusifolia* of Drake del Castillo (1893, p. 51), but is more commonly known as *Canavalia turgida* Grah.

Phaseolus adenanthus G. W. Mey.

32. Climbing over bushes, roadsides, District of Faaa, May 22 (with white flowers tinged with blue-purple, fading to buff). 93. High stout vine climbing over *Hibiscus tiliaceus*, shore swamp, Tapahi, District of Mahina, May 23 (without flowers or fruits). 165. Low vine, District of Faaa, May 27 (with flowers and pods); vine, crawling over stones, Punaruu Valley, District of Punaauia, June 15 (with flowers). Indigenous; pantropic. The Tahitian name "*Pipi*" is applied to this as well as to other Leguminosae.

Phaseolus lathyroides L.

41. Waysides, District of Faaa, May 22 (with flowers and pods). Introduced; pantropic weed; originally from America. Pancher (cf. Cuzent, 1860, p. 231, sub *P. suberectus*) states that it was introduced in 1845. It is more commonly known as *Phaseolus suberectus* L.

Vigna marina (Burm.) Merr.

138. Coarse vine climbing over bushes of coastal plain, Tapahi, District of Mahina, May 25 (with flowers and fruits). 186. High climbing vine, Purau Swamp, beyond Maraa Caves, District of Paea, May 29 (with pods). 334. Long vine (70-80 feet) hanging down over cliff near Maraa Caves, June 12 (with pods). Indigenous; pantropic strand plant; originally described from the East Indies and more commonly known as *Vigna lutea* A. Gray.

OXALIDACEAE

***Oxalis repens* Thunb.**

134. Frequent along roadsides, Tapahi, District of Mahina, May 25 (with fruits). Common in warmer portions of the Old World; indigenous to or early introduced into Tahiti.

****Averrhoa carambola* L.**

113. Tree, road over Tahara Mountain, District of Mahina, May 25 (with flowers). Pantropic in cultivation; originally from tropical America.

RUTACEAE

****Murraya paniculata* (L.) Jack.**

376. In gardens, Papeete, June 16 (with fruits). Pantropic in cultivation; native from India to Malaya. 555. Same locality, July (with flowers and fruits). It is more commonly known as *Murraya exotica* L.

***Citrus aurantium* L.**

201. Large trees, relics of cultivation, although afflicted with scale, bearing plentiful sweet, juicy fruit, Fautaua Valley, May 31 (with fruits). Introduced; native of Old World. Sir Joseph Banks (Journal edited by J. D. Hooker, p. 107, 1896), who accompanied Cook on his first voyage, speaks of planting seeds of various citrus fruits, oranges, lemons, limes, etc., which he had brought from Brazil, and earlier (pp. 37, 38) he speaks of the Brazilian oranges as being large and very juicy and of thinking them good. The orange tree no longer flourishes on the coastal plain but well up in the valleys orange trees are common, which without care produce abundance of delicious fruit. It may be presumed that these, or at least some of them, are the descendants of those introduced by Banks in 1769.

***Citrus medica* L.**

203. Large trees, seeming more resistant to scale than trees of *C. aurantifolia* in same locality, Fautaua Valley, May 31 (with flowers and fruits).

Citrus hystrix DC.

403. Gardens in Papeete, June 19 (with fruit). Cultivated; originally from the East Indies.

Citrus maxima (Burm.) Merrill

383. Fautaua Valley, June 16 (with fruits). So far as I know there is only a single tree, which must have been introduced early. The flesh of the fruit was found to be insipid. Pancher thinks that this species may be indigenous, but that is unlikely. It is more commonly known as *Citrus decumana* L.

Citrus aurantifolia (Christm.) Swingle?

199. Trees of good size, much affected by scale, but producing excellent limes, Fautaua Valley, May 31 (with fruit). These trees also may be descended from the Brazilian stock introduced by Sir Joseph Banks. It is more commonly known as *Citrus acida* L.

BURSERACEAE

***Canarium commune** L.

114. Tree, in garden, near Tahara Mountain, May 25 (with fruits). Said to have been brought from Madagascar; native of Java.

MELIACEAE

Melia Azedarach L.

326. Planted, particularly in cemeteries, Papeete, June 10 (with fruits). Introduced; native of China, now commonly cultivated in all warm countries. Pancher (cf. Cuzent, 1860, p. 229) states that it was introduced into Tahiti in 1832 by Captain Wilson.

EUPHORBIACEAE

Phyllanthus Niruri L.

63. Sandy soil along the seashore, frequent, District of Arue, May 22 (with flowers and fruits). Introduced (?); pantropic; probably native in the Old World.

Phyllanthus simplex Retz.

1. Rocky ground by roadside, District of Papenu, May 20 (with flowers and fruits). Introduced early (?); Old World tropics, from India and southern China, through Malaysia to Polynesia. The Tahitian name is "*Moemoe*."

Glochidion ramiflorum Forster

70. Small tree, lower end of Punaruu Valley, District of Puna-uaia, May 23 (with fruits). 416. District of Papeari, June 21 (without flowers or fruits but with deformed leaves). 546. Tahara Mountain, July 11 (with fruits). Indigenous, the species (in different varieties) extending to the Marquesas and to the Samoan Islands. The Tahitian name is "*Mahame*" and the Samoan, "*Masame*." The fruits of our specimens were green, opening to show the coral red seeds.

***Breynia nivosa** (Bull.) J. K. Small

374. Ornamental shrub, much used for low hedges, Papeete, June 16 (with flowers). Introduced; probably from cultivated stock from Hawaii. The commonly planted shrub with green and white variegated leaves, running into pinkish shades, is this cultivated species of uncertain origin.

Claoxylon taitense Muell.

249. Small tree, Fautaua Valley, June 3 (without flowers or fruits). Endemic.

***Macaranga taitensis* Muell.-Arg.**

342. Sapling, about 30 feet high, head of Orofere Valley, District of Paea, June 13 (without flowers or fruits). 422. Sapling with very large leaves, lower Maara Valley, District of Papeari, June 22 (without flowers or fruits). Endemic. Unfortunately neither flowers nor fruits were obtained to make the determinations certain.

***Acalypha hispida* Burm. f.**

322. Commonly cultivated, this collection in remnant of former garden, somewhere between Papenu and Tiarei, June 9 (with flowers and fruits). Introduced; pantropic in cultivation; a native of south-eastern Malaya. The natives call it "'Aeromimi."

***Acalypha Wilkesiana* Muell.-Arg.**

Cultivated, frequent, but no specimens were saved, though its red variegated leaves seem distinctive. It is said to be a native of Polynesia. In Tahiti I have not seen it otherwise than as an exotic.

****Acalypha Godseffiana* Mast.**

507. Planted for hedgerows in grounds of residence near the prison yard, Papeete, July 2 (with flowers). Introduced; a native of New Guinea, but now widely cultivated. The large, coarse-toothed leaves are green but when young show a conspicuous white border.

***Ricinus communis* L.**

262. Roadside, near Papenu, June 4 (with flowers). Pantropic; native of the Old World.

***Aleurites moluccana* (L.) Willd.**

15. Common along river banks and in gullies and cañons, Fautaua Valley, May 21 (with flowers and fruits). Possibly of aboriginal introduction; often cultivated from tropical Asia to Polynesia. The older Tahitian name "'Tutui" is similar to the Hawaiian "'Kukui," but the more common Tahitian designation, at present, seems to be "'Tahiri."

Jatropha Curcas L.

389. Experimental Garden, Papeete, June 19 (with young fruits). Cultivated; originally from Mexico.

Manihot utilisima Pohl.

140. Woody vine climbing over trees and bushes, near Tapahi, District of Mahina, May 25 (with fruits). Escape; native of tropical America. The "*Cassava*" or "*Tapioca*" is called "*Maniotu*" by the Tahitians. Pancher states (cf. Cuzent, 1860, p. 237) that it was introduced in 1850 by Admiral Bonard.

***Codiaeum variegatum (L.) Blume**

Various variegated leaved "Crotons" are cultivated and some are used for hedgerows. No study was made to determine the species accurately or to segregate the varieties. Pancher does not mention this species in his list of 1860.

Homalanthus Moerenhoutianus (Muell.-Arg.) Benth.

464. Slender tree, lower Vaitepiha River, June 22 (with flowers and fruits). 506 Above the falls, Maara River, District of Papeari, June 29 (with flowers and fruits). 529. Small tree, plentiful at 2500 ft. altitude, Diadem, July 8 (with flowers and fruits). Endemic.

Euphorbia atoto Forster

87. Tall herb, Tapahi, District of Mahina, May 23 (with flowers). Indigenous; a typical strand plant from tropical Asia, through Malaya to Polynesia and Australia. Tahiti is the type locality and the specific name is the Tahitian designation of the plant.

Euphorbia hirta L.

67. Abundant in cultivated soil, District of Arue, May 22 (with flowers). Pantropic weed; originally described from India.

Euphorbia pulcherrima Willd.

382. Commonly cultivated, Papeete, June 16 (with flowers). Introduced; originally from Mexico. Pancher states (cf. Cuzent, 1860, p. 237) that it was introduced into Tahiti in 1845 by Johnstone.

ANACARDIACEAE

Mangifera indica L.

172. Large tree near the Maraa Caves, District of Paea, May 27 (with blossoms). 281. Small tree near Papenu Bridge, June 5 (without flowers or fruits). Introduced; usually cultivated, probably spontaneous; originally from Indo-Malayan region. Pancher states (cf. Cuzent, 1860, p. 231) that the Mango was introduced into Tahiti in 1848 by Rear Admiral Le Goarant, and the variety "Pêche" in 1852 by Admiral Bruat. The Tahitians call the Mango, "*Vi Popa'a*" or "Foreign Vi," to distinguish it from the native "*Vi*" (*Spondias dulcis* Forst.).

***Anacardium occidentale** L.

472. Fair sized tree, edge of forest, District of Papeari, June 24 (with flowers). 482. Small tree by roadside near Punaruu Bridge, District of Punaauia, June 26 (with flowers). Sparingly cultivated and possibly spontaneous; introduced; originally from tropical America.

Spondias dulcis Forst.

288. Tree in garden, Papeete, June 5 (without flowers or fruits). 325. Tree, cemetery near Papeete, June 10 (without flowers or fruits). 350. Tree in garden, Papeete, June 13 (new leaves and scanty blossoms). 391. Experimental Garden, Papeete, June 19 (with few fruits remaining). Indigenous; first described from the Society and Tongan islands. The native name is "*Vi*," or to distinguish it from the Mango, "*Vi Tahiti*."

Rhus taitensis Guil.

457. Large tree near ford on Vaitepiha River near its mouth, June 23 (with remains of staminate inflorescence). 487. Large tree, rising higher than its neighbors, abundant, Maara Valley, District of Papeari, June 26 (with ripe, dark bluish-black fruits). Indigenous; central Polynesia (Tahiti west to Fiji). Agrees well with Decaisne's plate of *R. taitensis* in the Atlas of the Voyage of the Venus but has smaller fruits and differently shaped leaflets from the type of *R. simarubaefolia* A. Gray. No. 487 has 14, while 457 has 22 leaflets.

SAPINDACEAE

Cardiospermum Halicababum L.

34. Roadsides, District of Faava, May 22 (with flowers and fruits); in cemetery, Papeete, June 10 (with fruits). Having all the appearance of an introduced plant, although considered as indigenous by Pancher and Nadeaud; pantropic.

Sapindus saponaria L.

397. Tree in Experimental Garden, Papeete, June 19 (with fruits). The tree from which the specimen was collected was certainly planted and the source could not be ascertained. The species is native in Tahiti, the Marquesas, Hawaii, and generally pantropic. The fruits of our specimen are small (*S. microcarpa* Jard. or *S. saponaria* f. *microcarpa* Radlk.).

Dodonaea viscosa (L.) Jacq.

547. Shrub, Tahara Mountain, July 11 (with flowers and fruits, dioecious!). Indigenous; pantropic.

RHAMNACEAE

***Zizyphus jujuba (L.) Lam.**

394. Tall tree, Experimental Garden, Papeete, June 19 (with fruits). Introduced; native of tropical Asia.

Colubrina asiatica (L.) Brong.

92. Shrub, roadsides, District of Mahina, May 23 (with flowers and fruits). Indigenous; tropics of the Old World.

TILIACEAE

***Corchorus acutangulus** Lam.

66. Weed about habitations, District of Arue, May 22 (with flowers and fruits). Introduced; pantropic, but probably a native of tropical Asia.

Grewia crenata (J. R. and G. Forst.) Setchell

Carneg. Inst. Wash., Publ. 341, p. 72, 1924.

496. Large tree, abundant above the falls, Maara Valley, June 29 (with fruits). Indigenous; described from the Society and Tongan islands, Polynesia to Australia. Generally known as *Grewia Malococca* L. f.

Triumfetta Bartramia L.

53. Wayside weed, roadsides in District of Faaa, May 22 (with flowers and fruits). Introduced; pantropic weed; more commonly known as *Triumfetta rhombifolia* Jacq.

MALVACEAE

***Wissadula amplissima** (L.) R. E. Fries

74. Suffrutescent herb, roadsides, Punaruu Valley, District of Punaauia, May 23 (with fruits). 143. Same locality, May 26 (with flowers and fruits). Introduced; a native of tropical America.

Sida acuta Burm. f.

37. Waysides, District of Faaa, May 22 (with flowers and fruits). Introduced; a pantropic weed; originally described from the East Indies. Pancher (in 1860) notes it as an introduction (*Sida carpinifolia* L. f.).

***Sida spinosa** L. var. **angustifolia** (Lam.) Griseb.

38. Waysides, abundant, District of Faaa, May 23 (with flowers and fruits). Pantropic.

Urena lobata L.

131. Scarce, Tapahi, District of Mahina, May 25 (with flowers and fruits). Introduced (?); pantropic. Our plant is toward var. *scabriuscula* (DC.) A. Gray.

Hibiscus rosa sinensis L.

376. In garden, Papeete, June 16 (with flowers). 478. In garden, Papeete, June 24 (with flowers). Pantropic in cultivation; a native of the Old World. Pancher states (cf. Cuzent, 1860, p. 229) that it was introduced into Tahiti in 1845 by Johnstone. Wilkes, however, mentions it as a personal decoration in 1839 (Narr. U. S. Expl. Exp., vol. 1, p. 33, 1845). Several pink or pinkish to white flowered plants were noticed in cultivation, possibly of hybrid origin between this species and *H. Arnottianus* A. Gray.

***Hibiscus schizopetalus (Mast.) Hook.**

111. Cultivated, Tahara Mountain, District of Mahina, May 25 (with flowers). Pantropic in cultivation; a native of tropical Africa. Probably of comparatively recent introduction.

Hibiscus tiliaceus L.

49. Abundant on the coastal plain, District of Faaa, May 22 (with flowers and fruits). 448. Roadside, District of Papeari, June 22 (sapling not yet in flower but with trilobate leaves). Indigenous; pantropic. The Tahitian name is "*Purau*," although earlier the general Polynesian name "*Fau*" must have been used since any table covering, originally of *Purau* leaves, is still called "*Laufau*."

Hibiscus tricuspid (Sw.)

68, 29. Small tree, associated with *Hibiscus tiliaceus* L. near bridge at Papawa, District of Arue, May 22 (with flowers and fruits). 156. Same locality, May 27 (with flowers and fruits). Endemic. We noticed this species in only one spot where it grew intermingled with *Hibiscus tiliaceus*, which it closely resembles in habit. The species was first collected on Cook's first voyage, in 1769, probably in the same locality and possibly very near the same spot where we found our specimens. The species is found also in Fiji, likewise growing with *H. tiliaceus*. The Tahitian name is "*Faupapa*," according to Nadeaud (1873, p. 67).

Hibiscus vitifolius L.

178. Low shrub, roadsides, occasional but not common, District of Paea, May 29 (with flowers and fruits). Introduced; native of tropics of Old World. Pancher states (cf. Cuzent, 1860, p. 288) that it was introduced in Tahiti in 1855.

Abelmoschus moschatus Medic.

536. On cliff, Maraa Caves, District of Paea, July 8 (with dry fruits). Said to be indigenous; pantropic.

Thespesia populnea (L.) Soland.

89. Small tree by roadside, not common, District of Mahina, May 23 (with fruits). 321. Large tree on strand, Tiarei, June 9 (with fruits). Indigenous; typical strand tree of all tropics; not abundant in Tahiti. The native name is "'Amae.'" "*Miro*" is also given, similar to the "*Milo*" in Samoa and elsewhere.

Gossypium brasiliense Macf.

141. Cultivated, seemingly as an ornamental, Tapahi, District of Mahina, May 25 (with flowers and fruits). Pantropic in cultivation but a native of tropical America:

BOMBACACEAE

***Ceiba pentandra** (L.) Gaertn.

480. Occasionally planted, Maara, District of Papeari, June 25 (with flower buds). Pantropic in cultivation; possibly a native of tropical America.

STERCULIACEAE

***Heritiera litoralis** Dryand.

401. Experimental Garden, Papeete, June 19 (with fruits). Introduced; strand plant of the Old World.

GUTTIFERAE

Calophyllum Inophyllum L.

318. Large tree by seashore, Tiarei, June 9 (with fruit). 384. Large tree on strand, Arue, June 17 (with flowers). Indigenous; typical strand tree in Old World tropics from India and east Africa to Malaysia. A native boy gave me the name "*Moro'ati*," which seems to be good Tahitian. It is also called "'*Ati*" and "*Tamanu*," the last being the same as the Samoan name.

BIXACEAE

Bixa orellana L.

159. Roadsides, District of Arue, May 27 (with fruits). Escaped from cultivation; originally American, now pantropic, at least in cultivation. Pancher states (cf. Cuzent, 1860, p. 228) that it was introduced in 1845 by Johnstone.

COCHLOSPERMACEAE

***Cochlospermum hibiscoides Kunth.**

508. Large tree, lower Fautaua road, July 4 (in full flower). Introduced as an ornamental; native of Mexico. It is also referred to *Maximiliana vitifolia* (Willd.) Krug. and Urban, which is the *Cochlospermum vitifolium* (Willd.) Spreng.

PASSIFLORACEAE

***Passiflora foetida L.**

3. Roadside, District of Papenu, May 20 (with flowers and fruits). Introduced; pantropic weed of American origin.

***Passiflora laurifolia L.**

210. High climbing vine, Fautaua Valley, below the "Fort," May 31 (with flowers and fruits). Introduced; relic of former cultivation, originally from tropical America.

***Passiflora quadrangularis* L.**

200. High climbing vine, Fautaua Valley, below the "Fort," May 31 (with fruits). Introduced; pantropic, but originally from tropical America. It is probable that hybrid varieties of this have been introduced into Tahiti. Pancher mentions (cf. Cuzent, 1860, p. 233) *P. alata*, *P. Napoleonis*, and *P. Hamiltoniana*, the second introduced by Bishop d'Axieri in 1854 and the last by Johnstone in 1845.

CARICACEAE

***Carica Papaya* L.**

132. Staminate tree (pistillate, however, are common), Tapahi, District of Mahina, May 26, (with flowers). Naturalized; originally from tropical America, now pantropic. The Tahitian name is given by Pancher as "*Ita*."

THYMELEACEAE

***Wikstroemia foetida* L. f.**

276. Solitary bush beyond the bridge at Papenu, June 5 (with fruits). 319. Tall shrub, among bushes by roadside, Tiarei, June 9 (with flowers). 413. Shrub on hillside, in thicket, District of Papeari, June 21 (with flowers). Indigenous; all probably belonging to the endemic var. *tahitensis* A. Gray. The Tahitians with us called it "*Mou'a*" but it is usually spoken of as "*O'orau*."

LECYTHIDACEAE

***Barringtonia asiatica* (L.) Kurz.**

147. Single tree, strand at Outo-maoro, District of Punaauia, May 26 (with flowers). 385. Large tree, strand, District of Arue. Indigenous; typical strand tree from tropical Asia through Polynesia.

RHIZOPHORACEAE

Crossostyles biflora Forster

474. Banks of roadside, towards Port Phaeton, District of Papeari, June 24 (with flowers). 505. Maara Valley, District of Papeari, June 29 (with flowers). Tahiti contains the type locality for this central Polynesian species.

COMBRETACEAE

Terminalia Catappa L.

48. Trees along roadside, District of Faava, May 22 (with fruits). A typical strand plant through the tropics of the Old World but not in Tahiti. The older trees have probably been cut down; only younger trees were seen and these had been planted.

MYRTACEAE

Psidium Guajava L.

482. Roadside, near Punaruu Bridge, District of Punaauia, June 26 (with flowers). Spreading from tropical America, the Guava has infested many tropical countries, forming dense thickets. This is the case in Tahiti, where it is a pest. According to Pancher (cf. Cuzent, 1860, p. 232, sub *P. pyriferum*) it was introduced by Becknell in 1815. Other varieties were introduced later.

Decaspermum fruticosum Forster

524. At about 2500 ft. altitude, on ridge between east and west forks of Fautaua River, July 8 (without flowers or fruits). Indigenous; from India and China through Malaya to tropical Australia and Polynesia.

***Eugenia Cumini** (L.) Druce

371. Planted, Papeete, June 16 (with scanty fruits). Introduced; native of Malaya, now frequently planted in other tropical countries.

Eugenia Jambos L.

126. Roadside, Tahara Mountain, District of Mahina, May 25 (with flowers). 240. Street tree, District of Punaauia (?), June 2 (with flowers). Introduced; native of Malaya, but now planted in other tropical countries. Pancher (cf. Cuzent, 1860, p. 232, sub *Jambosa vulgaris*) considers it native to Tahiti.

Eugenia malaccensis L.

455. Near a house, District of Tautira, June 23 (with flowers). Cultivated and spontaneous (?); native of Malaya, cultivated elsewhere. The Tahitian name is "'Ahi'a," the Hawaiian "Ohi'a," but in Samoan "Nonu fiafia."

Eugenia Micheli Lam.

381. Frequent as an ornamental in gardens, Papeete, June 16 (with flowers and fruits). Cultivated; native of tropical America, generally called "Cherry" or "Cerisier de Cayenne." Pancher states (cf. Cuzent, 1860, p. 232) that it was introduced into Tahiti in 1848 by Johnstone.

Metrosideros collina (Forst.) A. Gray

117. Bush, or small tree, Tahara Mountain, May 25 (with flowers). Indigenous; broadly distributed through Polynesia. The Tahitian name is "Puarata."

Metrosideros collina var. glaberrima Bertero

125. A single low bush, Tahara Mountain, May 25 (with flowers). Endemic variety.

***Eucalyptus crebra F. v. M.?**

396. Experimental Grounds, Papeete, June 19 (in scant flower). Introduced; native of Australia. Seemingly a variety or form of this species. Similar trees were noticed in private grounds, but seldom in flower or fruit. Pancher does not mention any species of this genus in his list of 1860.

MELASTOMACEAE

Melastoma denticulatum Labill.

404. Roadside banks between Papenu and Faarapa, June 19 (young plant, not yet flowering). 450. Dry banks, roadside near Port Phaeton, District of Papeari, June 23 (with flower buds). 475. Same general locality, June 24 (with flowers). Indigenous; general through central Polynesia to New Caledonia.

OENOTHERACEAE

Jussiaea erecta L.

42. Roadsides, District of Faaa, May 22 (with flowers and fruits). Introduced, probably early; a pantropic weed.

Jussiaea repens L.

103. In shallow water, Ahonu Valley, District of Mahina, May 23 (with flowers and fruits). Established, probably of recent introduction; pantropic.

ARALIACEAE

Panax tahitensis Naud.

343. Slender unbranched tree, upper Orofere Valley, District of Paea, June 13 (with flowers). Endemic. Nadeaud (1873, p. 63) gives the Tahitian name of this species as "*Apape monoi*."

***Nothopanax Guilfoylei** (Cogn. and March.) Merr.

This species is commonly planted for hedges, but none were either seen or reported with flowers or fruits. It is of recent importation and is possibly of Polynesian origin.

PLUMBAGINACEAE

Plumbago zeylanica L.

70. Lower end of Punaruu Valley, District of Punaauia, May 23 (with flowers and fruits). 291. Upper Papehue River, District of Paea, June 7 (with flowers). 351. Near the bridge over the Punaruu River, District of Punaauia, June 14 (with flowers and fruits). Indigenous; tropics of the Old World.

OLEACEAE

Jasminum didymum Forster

80. Climbing over bushes, lower end of Punaruu Valley, District of Punaauia, May 23 (with scanty fruits). 297. Vine, commonly climbing over coffee bushes, Papehue Valley, District of Paea, June 7 (without flowers or fruits). Indigenous; ranging from Java to tropical Australia, New Caledonia, and Polynesia, with the type locality in the Society Islands.

LOGANIACEAE

Fagraea Berteriana A. Gray

486. Large trees, at 600–800 ft. altitude, Maara Valley, June 28 (with fruits). Indigenous; type region, confined to central Polynesia, Marquesas to Samoa.

APOCYNACEAE

***Allamanda cathartica** L.

Commonly cultivated and at times seemingly spontaneous; originating in tropical America.

Plumiera acuminata Ait.

Commonly planted as an ornamental and in several varieties. Pantropic in cultivation; originally from Mexico. Pancher states (cf. Cuzent, 1860, p. 235, sub *P. alba*) that it was introduced into Tahiti in 1852 by Abadie.

***Alstonia costata* (Forst.) R. Br.**

485. Slender tree, at about 800 ft. altitude, Maara Valley, District of Papeari, June 25 (with flowers and fruits). 525. Small tree, upper Fautaua Valley, July 8 (with fruits). Endemic in the Society Islands.

***Lochnera rosea* (L.) Reichenb.**

Commonly cultivated as an ornamental in all tropics, originally from tropical America. Pancher notes it in 1860 (cf. Cuzent, p. 235).

****Tabernaemontana divaricata* (L.) R. Br.**

554. Cultivated, garden of Tiare Hotel, Papeete, July 13 (in flower). (*T. coronaria* Willd.) A native of tropical Asia. The natives designate it as "*Tiare Moorea*."

***Alyxia scandens* Forster**

493. Low shrub, or more or less climbing, above the falls, Maara Valley, District of Papeari, June 29 (with fruits). Indigenous; central Polynesia.

***Cerbera manghas* L.**

324. Occasional tree, District of Papenu, June 9 (with fruits). 353. Tall trees in small associations, lower Punaruu Valley, District of Punaania, June 9 (with flowers). Indigenous; typical plant of coastal plain, Malaya to tropical Australia and Polynesia, more commonly known as *Cerbera Odollam* Gaertn. The Tahitian name is "*Reva*," called also "*Metua reva*" or "*Reva reva*." The name "*Reva*" seems also to be applied occasionally to the "*Hutu*" (*Barringtonia asiatica*).

****Thevetia peruviana* (Pers.) Merr.**

179. Planted, churchyard, District of Faava, May 29 (with flowers and fruits). Of recent introduction; originally from tropical America; now pantropic in cultivation. Usually known as *Thevetia nereifolia* Juss.

***Nerium indicum* Mill.?**

A *Nerium* is commonly cultivated and is probably of this species rather than of *N. oleander* L. No careful study was made nor specimens preserved. Pancher states (cf. Cuzent, 1860, p. 235) that *N. oleander* (*flore pleno*) was introduced by the English missionaries (probably early nineteenth century) and the double white by the Catholic missionaries in 1848, while a variety, "*Haqueville*," was introduced by Rear Admiral Bonard in 1850.

ASCLEPIADACEAE

***Asclepias curassavica* L.**

361. Well up the Punaruu River, District of Punaauia, June 15 (with flowers). 411. Roadside weed, District of Papeari, June 21 (with flowers and fruits). A pantropic weed, of American origin. Pancher states (cf. Cuzent, 1860, p. 235) that it was introduced into Tahiti by G. Orsmond in 1839. According to Hooker and Arnott (Bot. Beechey, p. 66, 1832), it was collected in Tahiti by Lay and Collie as early as 1826.

CONVOLVULACEAE

***Merremia peltata* (L.) Merr.**

126a. Long woody vine, clambering over rocky slopes, Tahara Mountain, May 25 (without flowers or fruits). 475. Climbing high over trees and bushes, roadside, near Maara, District of Papeari, June 24 (with capsules). Indigenous; from southeastern Asia to Australia and Polynesia. The species was plentiful in the coastal plain region but we saw no flowers (said to be white) and only once encountered capsules and flower buds. The Tahitian name is "*Pohue*."

****Merremia umbellata* (L.) Hallier f.**

161. Roadside, District of Arue, May 27 (with fruits). 332. Roadsides, District of Faava, June 10 (with yellow flowers). Introduced; pantropic; originally described from the West Indies.

***Ipomoea Batatas* (L.) Poir.**

Commonly cultivated under the name of "'*Umara*.'" Considered to have been cultivated by the Tahitians previous to the advent of Europeans.

***Ipomoea dissecta* Choisy.**

148. Clambering over stone wall, District of Punaauia, May 26 (with flowers and fruits). Appearing like an introduced plant, but spontaneous. Originally described from "Guinea."

***Ipomoea gracilis* R. Br.**

136. Roadside, Tapahi, May 25 (with flowers and fruits). 461. Roadsides in the District of Papeari, June 23 (with flowers and fruits). Indigenous; tropical Asia to the Seychelles, through Malaya to tropical Australia and Polynesia.

***Ipomoea obscura* (L.) Ker.**

51. Floor of quarry, District of Faaa, near Papeete, May 22 (with flowers). 327. Same locality, June 10 (with fruits). Indigenous(?); tropics of the Old World.

***Ipomoea pes-caprae* (L.) Roth**

119. Extensive beach association beyond Tahara Mountain, District of Mahina, May 25 (with flowers and fruits). A pantropic strand plant, of all oceans.

***Stictocardia campanulata* (L.) House**

146. High climbing vine near Punaruu Bridge, District of Punaauia, May 26 (with flowers). 292. Climbing high over trees, Papahue Valley, District of Paea, June 7 (with flowers). 387, 387a, 388. Same locality as 146, June 18 (with flowers, fruits, and ripe seeds). Introduced; native from India to Malaya.

****Cuscuta pentagona* Engelm.**

12. On *Sonchus*, along the roadsides, Tahara Mountain, May 20 (with flowers and fruits). 228. On *Tithonia diversifolia* A. Gray, between Papeete and Papeari, June 2 (with flowers and fruits). Introduced; probably originally American but now widespread. I have to thank Professor T. G. Yunker for the determination of my specimens.

BORAGINACEAE

***Cordia subcordata* Lam.**

287. Strand tree, Papetoai, Island of Moorea, June 7 (with flowers and fruits). 463. Sandy soil, village of Tautira, June 25 (with fruits). Indigenous; typical strand tree, from East Africa through the tropics of the Old World to Polynesia. The Tahitian name is "*Tou*." It is in much demand for timber for shipbuilding and large trees are very rare on Tahiti.

VERBENACEAE

***Lantana camara* L.**

55. Wayside thickets, District of Faaa, May 22 (with flowers and fruits). An all too common introduced pest; originally from tropical America, now pantropic. Pancher states (cf. Cuzent, 1860, p. 236) that it was introduced into Tahiti in 1843 by Captain Chappe of the Marines.

****Stachytarpheta jamaicensis* (L.) Vahl**

120. Coarse weed, abundant along roadsides, Tahara Mountain, May 25 (with flowers and fruits). Pantropic weed; originally from tropical America, apparently of recent introduction into Tahiti.

****Tectona grandis* L. f.**

402. Large tree, Experimental Garden, Papeete, June 15 (with fruits). The Teak tree is often planted and some of the trees are of large size; originally from tropical Asia. It is not mentioned by Pancher in 1860.

***Premna tahitensis* Naud.**

459. Shrub, or small tree, in bush, banks of lower Vaitepiha River, June 23 (with flowers and fruits). Indigenous; Marquesas to Fiji Islands.

Clerodendron fragrans Vent.

13. Extensive thicket of low bushes along the road to Papenu River, May 20 (with flowers). Spontaneous; native of southeastern Asia, now pantropic in cultivation. Pancher states (cf. Cuzent, 1860, p. 236) that it was introduced into Tahiti in 1845 by Johnstone.

***Clerodendron mite** Vatke

157. Along roadside, District of Arue, May 27 (with flowers and fruits). Escaped from gardens; originally from the East Indies.

***Clerodendron speciosissimum** Paxt.

373. Tall garden shrub, Papeete, June 16 (with flowers and fruits). Cultivated ornamental, the garden name, given above referring to *C. squamatum* Vahl from India and Burma.

***Duranta stenostachya** Tod.?

300. Large tree, Experimental Garden, Papeete, June 19 (with last flowers). Cultivated, seemingly of this species; originally from Brazil.

LABIATAE

Leucas decemdentata Sm.

406. On wet bank, between Papenu and Faarapa, June 19 (with flowers and fruit). Indigenous; Polynesian.

***Leonurus sibiricus** L.

233. Roadside, Maara, District of Papeari, June 2 (with flowers and fruit). Introduced; a native of Asia, now in all warm countries.

***Salvia occidentalis** Sw.

52. Roadsides, plentiful, District of Faava, May 22 (with flowers and fruits). 167. Same locality, May 27 (with flowers and fruits). Introduced weed; originally from Atlantic tropical America. From its odor it is called "*Miri*," the same name being given to "Sweet Basil."

****Coleus Blumei* Benth.**

188. Roadsides, often plentiful, District of Paea, May 29 (with flowers). The variegated *Coleus*, in many variations, has escaped from cultivation and often borders the roads for long distances, especially on the moister sides of the island. It is probably a native of Java and is of comparatively recent introduction.

***Ocimum Basilicum* L.**

107. Papeete, May 25 (with fruits). The "*Miri*" was brought me by a Tahitian, who called it "*Miri*," the ordinary Tahitian name for it. It is cultivated and is probably native to tropical Asia.

****Ocimum gratissimum* L.**

152. Tall mint, frequent along the roadsides in the District of Faaa and Punaauia, May 26 (with flowers and fruits). Introduced.

SOLANACEAE****Physalis lanceifolia* Nees**

232. Weed along roadside, scanty, Maara, District of Papeari, June 2 (with flowers and young fruits). Introduced; native of Mexico.

***Solanum nigrum* L.**

137. Moist roadsides, scarce, Tapahi, District of Mahina, May 25 (with flowers and fruits). Introduced (?); taken in broad sense, the species is cosmopolitan.

***Capsicum frutescens* L.**

145. Common, along roadsides, near Punaruu Bridge, District of Punaauia, May 26 (with fruits). Introduced; originally from tropical America. The Tahitians call it "*Oporo*," because of its resemblance to *Solanum Uporo* Dunal.

****Datura arborea* L.**

217. River-borders, Fautaua Valley (below the falls), May 31 (with flowers). Introduced; native of Peru and Chile.

***Cestrum diurnum L.**

481. Tall shrub, roadside, District of Arue, June 25 (with flowers and fruits). Introduced; native of the West Indies.

SCROPHULARIACEAE

Lindernia crustacea (L.) F. Muell.

405. Prostrate herb on wet banks, District of Papenu, June 19 (with fruits). Indigenous; India to China, through Malaya into Polynesia, and more commonly known as *Vandelia crustacea* Benth. It is officinal among the Tahitians.

BIGNONIACEAE

Stenolobium stans (L.) D. Don.

144. Tall shrub, valleys and hillsides, Tapahi, District of Mahina, May 25 (with ripe pods). 171. Roadside shrub or small tree, everywhere on dry soil, roadsides, valleys, and cliffs, District of Arue, May 27 (just coming into flower). 225. Shrub, roadside, Papeete, June 1 (with flowers). Escape; originally from tropical America.

Of the three introduced shrubby species which have spread in Tahiti and changed the landscape features generally, the present species, or Yellow Elder, has mounted highest on the dry slopes, even up to two or three thousand feet of altitude. According to Pancher (cf. Cuzent, 1860, p. 235) it was introduced by Johnstone in 1845, but now is a conspicuous element on the drier northwesterly slopes. Of the other two species alluded to, the Guava forms its dense associations near the habitations of man and the Lantana extends somewhat above the Guava, but the Yellow Elder seems destined ultimately to clothe even the highest slopes.

GESNERIACEAE

****Achimenes grandiflora* DC.**

192. Fautaua Valley, neighborhood of the "Fort," May 31 (without flowers or fruits). 259. Foot of Rainbow Falls, Fautaua Valley, June 3 (with flowers). Escaped from an ornamental garden existing earlier in Fautaua Valley; originally from Mexico.

***Cyrtandra Parksii* sp. nov.**

Plate 23

Suffrutescens omnino glabra, usque ad 1-1.5 m. alta, robusta, sparse ramosa; ramis tetragonis, usque ad 1 cm. diam., brunneis, cicatricibus latibus semilunatisque infero ornatis; foliis oppositis, ad apices ramorum aggregatis, laminis late obovatis usque ad oblongo-ellipticis, apice late leviterque retusis usque ad distincte et late acuminatis, basim longe et anguste attenuato decurrentibus, 10-20 cm. longis, 6-12 cm. latis, supero viridibus, infero dilute brunneis, venis primariis lateralibus utrinque 8-10, marginibus integerrimis aut obscurissime crenulatis, leviter revolutis; petiolis robustis, 1-3 cm. longis; cymis lateralibus, foliis usque tertio aut duplo brevioribus, laxis, leviter (2-3 plo) decompositis, multifloris, pedunculis 2-3 cm. longis, robustis, bracteis amplis, 2 cm. longis, primo monophyllis deinde profunde 2-3 fissis, laete coloratis, per anthesem persistentibus, post anthesem omnino deciduentibus; pedicellis rectis, 1-2 cm. longis, calycibus amplis, lente inflatis, usque ad 2 cm. longis, alabastro longe apiculato, ultimo 5-partitis, lobis, 1 cm. altis, basim 0.5 cm. latis, superis maximis; corollis 5 cm. longis, albis, odoratis, tubo 2.5-3 cm. longo, rectis, supero lente latescente, limbo lato usque ad 3-3.5 cm. in diam. max.; stylis elongatis, 2 cm. altis, stigmatibus duobus late breviterque spatulatis, 2 mm. latis; baccis ignotis. (Type, Herb. Univ. Calif., No. 219776.)

90. On dripping cliff by roadside, Tapahi, District of Mahina, May 23 (with flowers). 265. Same spot, June 4 (with flowers). 273. Same spot, June 5 (with flowers).

All the specimens of this proposed new species came from the same plant. It clearly belongs to Section 12, "*Aureae*" of C. B. Clarke (A. and C. De Candolle, Mon. Phanerog., vol. 5, p. 259, 1883). It differs from the three Tahitian species of that section in being either absolutely glabrous or in shape of leaf, dimensions of peduncle, calyx, corolla, etc. It appears to approximate most closely *C. Nadeaudii* C. B. Clarke, in dimensions of subsistent glabrous calyx, glabrous straight corolla tube, and in dimensions of both tube and limb of the corolla. The lengths of peduncle and pedicels are not given for

C. Nadeaudii but are probably shorter than in *C. Parksii*, judging from Drake del Castillo's statement (1893, p. 145) that the cymes are contracted. *Cyrtandra Nadeaudii* is said to be a tree 3-4 meters high, while *C. Parksii* is shrubby and only a little over 1 meter high. It is a very different plant from either *C. biflora* Forster or *C. tahitensis* Rich. No. 76 of Tilden's South Pacific Plants from the District of Papenu, distributed as *C. biflora* Forst., is the same species, possibly from the same locality or even the same plant.

***Cyrtandra Bidwillii* C. B. Clarke**

344. Shrub, 2-3 meters high, Orofere Valley, District of Paea, June 13 (with scanty white flowers and abundant fruits). 504. Above the falls, Maara Valley, June 29 (with flower buds). Endemic.

The bright rusty pubescence over the youngest parts seems to mark this species as distinct from *C. biflora* Forster. Unfortunately only a single flower was found on No. 344, with bracts already fallen. The berry is robust, oblong, tapering very little towards either apex or base. It is (in dried specimens) 15-20 mm. long and 8-10 mm. thick. No. 504 has young inflorescences with large monophyllous involucre, after the fashion of *C. biflora*.

***Cyrtandra apiculata* Nadeaud**

273a. District of Tiarei, June 5 (with fragrant flowers). 433, 495. Shrub, 3-4 meters high, above the falls, Maara Valley, June 29 (with fruits). 503. Tall shrub, same locality as last, June 29 (with fruits). Endemic.

Cyrtandra apiculata Nadeaud and *C. mucronata* Nadeaud are most readily to be distinguished from *C. biflora* Forster and *C. Bidwillii* C. B. Clarke by their acuminate leaves. They both have the young parts bright ferruginous tomentose, by which they are to be distinguished from *C. biflora*, and it is to be presumed that the bracts are not connate. In No. 273a, however, we have a plant with the ferruginous younger parts acuminate leaves and bracts connate about the youngest buds. The other three numbers are in fruit and the bracts have fallen. I have placed our specimens of these numbers (even including No. 273a) under this species, since they agree with the descriptions and even with Drake del Castillo's figure (cf. Ill. Fl. Ins. Mar. Pac., fasc. 5, pl. 46, 1889) with the exception of the bracts, but the older bracts are split apart even to the base (just as represented in Drake's figure).

PLANTAGINACEAE

Plantago major L.

266. Noticed in one locality, near Huau, District of Tiarei, June 4 (with fruits). Introduced; probably originating in Europe. Seems to be scarce in Tahiti. Collected by Bertero and Moerenhout in 1834 but not found by Lay and Collie in 1826.

RUBIACEAE

Ophiorrhiza scorpioidea Naud.

424. On dripping mossy banks, lower Maara Valley, District of Papeari, June 22 (with fruits). Endemic.

Neonauclea Forsteri (Seem.) Merr.

14. Large tree, river-bank, Fautaua Valley, May 21 (with flowers). Indigenous; extends from Philippine Islands to the south-east through Polynesia; more commonly known as *Nauclea Forsteri* Seem.

Tarenna sambucina (Forster) Durand

275. Small tree, District of Papenu, June 5 (with fruits). Indigenous; central Polynesia.

Gardenia tahitensis DC.

375. Cultivated, gardens about Papeete, June 17 (with flowers). Having all the appearance of an introduced ornamental, yet earlier than European contact; possibly a native of Samoa. This is the well-known "*Tiare*" or "*Tiare Tahiti*," the national flower of the Tahitians.

Plectronia barbata (Forster) Benth. and Hook.

81. Shrub, lower Punaruu Valley, District of Punaauia, May 23 (with flowers and young fruits). 304. Low shrub, Papehue Valley, District of Paea, June 7 (with flowers). 412. Tall shrub, hillsides, District of Papeari, June 21 (with flowers and fruits). 452, 454. Tall shrub, hillsides, District of Papeari, June 23 (with flowers and red fruits). Indigenous; central eastern Polynesia.

Guettarda speciosa L.

466. Unbranched sapling, seashore, Tautira, June 23 (without flowers or fruits). Indigenous, pantropic (or at least in the Old World) as a strand plant. The Tahitians named it "*Tapano*," Nadeaud gives "*Tafano*," and Cuzent "*Taffano*."

Coffea arabica L.

82. Spontaneous, lower Punaruu Valley, District of Punaauia, May 23 (with fruits). 545. Garden, Papeete, July 8 (with flowers). Spontaneous and cultivated; originally from southwestern Asia.

Ixora fragrans (Hook. and Arn.) A. Gray

312. Shrub, on cliff at about 2000 ft. altitude, Orofere Valley, June 8 (with flowers and young fruits). Endemic.

Ixora spec.

Several species or varieties with large and variously colored flowers are in cultivation.

Coprosma tahitensis A. Gray

254. Slender tree with small umbels of fragrant white flowers, infrequent, Fautaua Valley, June 3 (with flowers and fruits). An endemic species but our specimens agreeing partly with the descriptions of *C. tahitensis* A. Gray and partly with the description of *C. Nadeaudiana* Drake.

Geophila herbacea (Jacq.) O. Ktze.

10. Forming dense mats under trees, District of Mahina, May 20 (with fruits). Indigenous, or of aboriginal introduction; pantropic; more commonly known as *Geophila reniformis* D. Don.

Morinda citrifolia L.

129. Frequent in the coastal belt, Tapahi, District of Mahina, May 25 (with flowers and fruits). Indigenous or of aboriginal introduction; India to Polynesia.

***Vangueria edulis** Vahl

400. Small tree, Experimental Garden, Papeete, June 19 (with green fruit). Apparently of this species; a native of Africa.

CUCURBITACEAE

Momordica Charantia L.

34a. Roadsides, abundant, District of Faaa, May 22 (with flowers and fruits). Thoroughly spontaneous; said to have escaped from Chinese cultivation; pantropic.

Luffa cylindrica (L.) M. Roem. var. **insularum** Cogn.

219. Climbing over bushes at low altitudes, Fautaua Valley, May 31 (with flowers and fruits). Indigenous or of aboriginal introduction; pantropic in cultivation.

Lagenaria leucantha (Duch.) Rusby

The Calabash Gourd (usually recorded as *Lagenaria vulgaris*) has been cultivated in Tahiti since aboriginal days and is still found in outlying districts where the dried and prepared gourds are used as bottles.

CAMPANULACEAE

Isotoma longiflora (Mill.) Presl.

169. On dripping banks at Maraa Caves, District of Paea, May 27 (with flowers). 183. Same locality, May 29 (with flowers and fruits). 229. Same locality, June 2 (with fruits). Introduced, apparently sparsely spontaneous; native of tropical America. The Tahitians call it "*Apetahi*," the same name as that given to *Apetahia raiatensis* II. Bn.

COMPOSITAE

***Vernonia cinerea** (L.) Less.

57. Waysides, District of Faaa, May 22 (with flowers (blue) and fruits). Introduced; native of the Old World, now a pantropic weed.

***Elephantopus mollis** H. B. K.

43. Very abundant, waysides and fields, District of Faaa, May 22 (with flowers and fruits). This wayside weed of very recent introduction, a native of Mexico, is much disliked by the people of Tahiti, who call it "False Tobacco." The Tahitians call it "'Ava'ava" and "'Ava'a."

***Ageratum conyzoides L.**

222. Fautaua Valley at low altitude, May 31 (with flowers and fruits). An occasional weed, pantropic, but of American origin.

***Erigeron albidus (Willd.) A. Gray**

331. Roadside, Tahara Mountain, June 11 (with fruits). 355. Roadside, near Punaruu River, District of Punaauia, July 14 (with fruits). Introduced; occurs in all warm countries. This is probably the same as *E. sumatrensis* Retz.

***Xanthium strumarium L.**

187. In coconut grove, near house by "Marae," District of Faaa, May 29 (with fruits). Introduced; cosmopolitan.

***Eclipta alba (L.) Hassk.**

139. On dripping cliffs, Tapahi, District of Mahina, May 25 (with flowers and fruits). Introduced weed; found in all warm countries.

***Tithonia diversifolia A. Gray**

227. Wayside, between Papeete and Papeari, June 2 (with flowers and fruits). Sparsely spontaneous; a native of Mexico.

***Synedrella nodiflora Gaertn.**

54. Waysides, very common, District of Faaa, May 22 (with flowers and fruits). A too common pest along roads and in fields; pantropic but of American origin.

***Bidens pilosa L.**

121. Waysides, Tahara Mountain, May 25 (with flowers and fruits). A wayside pest; introduced; pantropic.

Emilia sonchifolia (L.) DC.

56. Waysides, frequent but scattered, District of Faaa, May 22 (with deep orange flowers and fruits). Introduced weed; pantropic; of Old World origin.

Sonchus oleraceus L. var.

163. Waysides, District of Faaa, May 27 (with flowers and fruits). Introduced; all warm countries. Noted by Pancher as early as 1860.

EXPLANATION OF PLATES

PLATE 23

Cyrtandra Parksii Setchell

Photograph of type specimen (No. 90). $\times 0.375$ diam.

Photographed by W. C. Matthews.



Plants of Tahiti Society Islands

Ardisia cuneata (L.) Presl
 Leaves leathery, ovate-lanceolate,
 with on midrib veins, in
 leaflets, mostly on part.

PLATE 24

Langevelidia scissilis (J. R. and G. Forst.) Setchell var.? *maraaensis* Setchell

Photograph of type specimen (No. 181). $\times 0.375$ diam.

Photographed by W. C. Matthews.



PLATE 25

Langevelgia sessilis (J. R. and G. Forst.) Setchell var. ? *maracensis* Setchell

Photograph of type specimen (No. 170). $\times 0.375$ diam.

Photographed by W. C. Matthews.



PLATE 26

Langeveldia sessilis (J. R. and G. Forst.) Setchell var.† *Forsteri* Setchell

Photograph of type specimen (No. 426). × 0.375 diam.

Photographed by W. C. Matthews.



PLATE 27

Langeveldia sessilis (J. R. and G. Forst.) Setchell var. ? *Forsteri* Setchell

Photograph of type specimen (No. 419). $\times 0.375$ diam.

Photographed by W. C. Matthews.



PLATE 28

Langevelidia sessilis (J. R. and G. Forst.) Setchell var. † *fautauensis* Setchell

Photograph of type specimen (No. 522). $\times 0.375$ diam.

Photographed by W. C. Matthews.



PLATE 29

Balanophora pallens (Soland.) Setchell

Photograph of No. 189. On the lower left hand corner is seen an erect stem with capitate pistillate inflorescence and below it thickly placed staminate flowers. Nat. size.

Photographed by W. C. Matthews.



PLATE 30

Balanophora pallens (Soland.) Setchell

Photographs of three specimens of No. 189. On the lower right is shown
a young plant cut vertically. Nat. size.

Photographed by W. C. Matthews.



PLATE 31

Peperomia Moerenhoutii C. DC.

Photograph of No. 23. $\times 0.4$ diam.

Photographed by W. C. Matthews.



HINT 17 18 19 20

Mossenhauer C. DC.

PLATE 32

Peperomia Moerenhoutii C. DC. var. *macrophylla* var. nov.

Photograph of type sheet of specimens. No. 289 (Herb. Univ. Calif.,
No. 219837). $\times 0.4$ diam.

Photographed by W. C. Matthews.



Hesperis matronalis L. var. *maculata* L.

PLATE 33

Pepcromia Mocrenhoutii C. DC. var. *subglabra* var. nov.

Photograph of type sheet of specimens. No. 182 (Herb. Univ. Calif.,
No. 219964). $\times 0.4$ diam.

Photographed by W. C. Matthews.



Piperaceae

Plants of Tahiti Society Islands

HERBARIUM OF THE
UNIVERSITY OF CALIFORNIA
710418

Morenhoutia van Sieboldii

T. van S.
Oct 1891

PLATE 34

Peperomia Hombronii C. DC.

Photograph of specimen of No 540. $\times 0.4$ diam.

Photographed by W. C. Matthews.



Planta (Tahiti B. civillind)

1. *Hombrovia* L. DC.

HERBARIUM 711
1 4 20

1 V 027 0-
1 " 1 " 4-
1 " 1 " -

PLATE 35

Peperomia pallida (Forst.) A. Dietr. var. *acuminata* var. nov.

Photograph of type sheet of specimens of No. 252 (Herb Univ. Calif,
No. 219839). $\times 0.4$ diam.

Photographed by W. C. Matthews.



1

16

Palladiuma virens L.

16

PLATE 36

Peperomia pallida (Forst.) A. Dietr. var. *longespicata* var. nov.

Photograph of type sheet of specimens of No. 502 (Herb. Univ. Calif.,
No. 219833). $\times 0.4$ diam.

Photographed by W. C. Matthews.



Cyrtosperma
valleyi

Plants of Tahiti Society Islands

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210032

Callitriche
var. longifolia

No

PHYTOGEOGRAPHICAL NOTES ON TAHITI

I. LAND VEGETATION

BY

WILLIAM ALBERT SETCHELL

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PHYTOGEOGRAPHICAL NOTES ON TAHITI

I. LAND VEGETATION

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WILLIAM ALBERT SETCHELL

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EDITOR'S NOTE

The study of insular floras, together with hypotheses as to their origin, received great impetus from Charles Darwin, who in his *Origin of Species* devotes some space to the arguments for organic evolution to be derived from the often seemingly discordant facts of geographical distribution of plants and animals. In 1867, J. D. Hooker, in his lecture before the British Association for the Advancement of Science at Nottingham, chose *Insular Floras* for his topic and the hypotheses as to their origin as his particular contribution. He dwelt particularly upon the floras of the "Atlantic Islands," of the Islands of St. Helena, Ascension and of Kerguelen Land. Alfred Russell Wallace in his *Island Life*, in 1880, brought much experience and careful thought to bear on the facts and hypotheses as to the origin of insular floras as well as faunas. In the Report of the Scientific Results of the Voyage of H.M.S. Challenger during the years 1873-76, the whole of the first huge volume on Botany was devoted to accounts and discussion of insular floras, prepared by William Botting Hemsley. These fundamental treatises have been supplemented by various studies and discussions of insular floras and their origins, both of earlier and of more recent dates.

Of the strictly oceanic islands of the Pacific, most of the attention has been centered upon the flora of Hawaii with less attention, particularly as to discussion, upon those of Fiji, Samoa, Tonga, Rarotonga, and Easter Islands. The flora of Tahiti, of which we have a fair knowledge, although probably far from complete, has appeared little in discussions even though it was the first to be investigated. Since it was my own good fortune to obtain some knowledge and experience, though small, of this particularly interesting island during the summer (Tahiti's winter) months of 1922, it seems desirable to make the attempt to analyze some of the more evident features of its flora, both from the topographic and floristic points of view.

TOPOGRAPHIC AND GEOLOGICAL NOTES

The island of Tahiti is situated in the south Pacific Ocean, about 17 degrees of latitude south of the equator and 149 degrees of longitude west of the meridian of Greenwich (position of Mota Uta in Papeete Harbor lat. 17° 31' 39" S, long. 149° 34' 16" W). It is one of the Society group, largely of "high" islands of volcanic origin and with the "high" Marquesas (to the northeast) and the "low" Tuamotu groups (nearly west) forms the easternmost strictly oceanic island of the Pacific Ocean or of Polynesia (used in the broad sense). To the south or west is the Cook group with Rarotonga as the high island and to the southeast the Gambier group with the moderately high island of Mangareva, while to the west there are no high islands until Samoa and Tonga and the still more westerly Fiji, and to the northwest the high islands of Hawaii are met. The distances between the Society group and the nearest high islands are three or more hundreds of miles while the westerly and northwesterly groups are in every case a thousand miles or more distant.

Tahiti is a double island, of two unequal, deformed circular, or seemingly elliptical masses, the larger being Tahiti proper, "Tahiti Nui," the smaller known as the Taiarapu Peninsula, "Tahiti Ita," joined by the low and narrow isthmus of Taravao.

In height, Tahiti rises, in the nearly central peak of Orohena, to 7321 feet, while the Taiarapu Peninsula culminates in the slightly eccentric Roniu, a peak of an altitude of 4341 feet. The Isthmus of Taravao, joining the two land masses, is low and contracts to approximately one mile in width. The entire island is approximately twenty miles long and ten miles in greatest width. The total area is given as about 350 square miles (cf. Crampton, 1916, p. 15), Tahiti Nui being somewhat over twice the area of Tahiti Iti.

There is a coastal plain, seldom as much as a mile in width, and usually very narrow, interrupted at various places by bold cliffs or promontories. This coastal plain may consist of decomposed volcanic rock material or of coral rock débris, or commonly of both more or less intermingled. The coastal plain, when narrow and level, may be raised only slightly above the high water line, but even when broader usually rises only slightly inland. In most cases it ends toward the interior at the base of a higher or lower cliff or steep slope.

It seems always to be formed over a dead fringing reef projecting out from a cliff or steep slope, the old reef having its surface at the present high water level or just below it. From the cliff tops or from the coastal plain, the interior rises at a steep slope toward the center of the mass in both Tahiti and in the Taiarapu Peninsula. While the slope of the main island is interrupted by deep and mostly narrow valleys, the general conical contour can readily be recognized. No better idea may be obtained than that from the series of relief maps presented by Crampton in his discussion of the Partulas of Tahiti (1916). In these, the relation of general slope to valley is to be seen (especially on pl. 9), but even these fail to convey the extreme depth of the valleys as compared with their width. Crampton's account may be consulted also for the physical and biotic features of each different valley since he has made an exhaustive survey for the purposes of his work.

The mass of both Tahiti Nui and of Tahiti Iti (or Taiarapu) is volcanic, with a history of varied flows of lavas at various periods in its history. The island probably was erupted as a whole or in connection with its sister island Moorea in a common dome-shaped flow, arising out of a general basal mass which had two principal centers of eruption, the one culminating in Aorai, the other in Ronui. We may perhaps also think of these two masses of Tahiti as originally more or less perfect cones whose sides have been deeply eroded and more or less radially dissected since their formation. Secondary eruptive centers are, at least, not so conspicuous, e.g., on Hawaii or Oahu. It is probable that the island of Moorea arose from the same rift series as the twinned Tahiti, since there is a submarine ridge connecting the two, but it emerged earlier than Tahiti and stood emergent when the ocean level was below its present situation if one may judge by the deeper and more considerable drowned valleys on Moorea than exist along the shores of Tahiti. We may presume that the main islands of the Society group are built from the extrusions of a general fissure or a more or less parallel series of short fissures, through which a basal mass or dome rose from a depth of 15,000 to 18,000 feet up to 9,000 or 10,000 feet, then erupted, more or less successively, Moorea, the twinned Huahine, the twin islands Raiatea and Tahaa, at present the center of the group and all showing deeply penetrating drowned valleys; and later Bora Bora at the northwest and the double mass of Tahiti at the southeast. There is no trace of emergent limestone formation on Tahiti, except possibly one a few feet

high, along a local fault line on the coast near Atiue, but nothing to indicate that the ocean level ever reached appreciably higher than it does at present unless a few arched rocks and seeming wave benches (especially off Tapahi on the northwest coast) may be construed as indications of such. I have not seen any general indications, but my examination in this direction has necessarily been exceedingly cursory. On the other hand, and as has been brought forward in the foregoing, there are strong indications in the drowned valleys of the other large islands of the group that the ocean level has been much lower relative to the present condition, and indications are not wanting in the case of Tahiti, although they are far less pronounced in the case of Tahiti than in that of other members of the group. All the islands mentioned possess distinct and encircling barrier reefs, separated by deep lagoon moats from the protected fringing reefs. In all except Tahiti, the barrier reefs completely enclose the islands (except, of course, where "passes" interrupt the continuity). In Tahiti, the extremities (northwest and southeast in the cases of both Tahiti Nui and Tahiti Ita) lack barrier reefs but their place is taken and the continuity completed by "banks" which in places approach within two or three fathoms of the surface. It seems logical to assume that the separate vents of extrusion were central and elongated and that the extremities and possibly the central axis remained active longer than the sides, thus inhibiting reef formation at these points and on the northeast side of the Isthmus of Taravao, where the two Tahitian vents come together.

EDAPHIC CONSIDERATIONS

The soils of Tahiti are largely shallow and mostly not thoroughly decomposed. They arise from disintegrated lavas or volcanic muds, mixed along the coastal plain with coral and shell débris. Aside from tracts long cultivated, they seem to be poor in decomposed organic materials. They vary in color from light yellow or yellowish red to deep red and even to black. On the slopes and ridges above the coastal plain the rocks are weathered into a coarse light-colored soil, while in the valley bottoms, what scanty soil there is, is finer and dark colored. The soils bear every mark of late arrival at their present state and are in accordance with other features of the twinned Tahiti, indicating youth rather than age among Polynesian islands.

The lavas, or igneous rocks, composing Tahiti have been treated by various authors, the latest account being that of Iddings (1916, 1918).

It is interesting to note that even Daly (1916a) lists Bora Bora among the "Islands of Oceania showing outcrops of 'Continental' rocks," although interpreting Marshall's quotation of Ellis's statement as to the occurrence of a "Quartz Feldspar rock" in that island as doubtful and needing definite confirmation. Washington (1921, p. 337) follows Lacroix and Iddings in considering this to be a dolerite (basalt).

CLIMATIC CONSIDERATIONS

Tahiti is situated near the lower edge of the tropical zone yet well within it. A record of temperature has been kept at one station or another near Papeete for many years and has been published in the official journal of the provincial government. Unfortunately there are serious gaps in the published record. Crampton (1916) has given the details for the five years from 1901 to 1905 and for them I refer to his account.

The temperature along the protected coast probably never goes below 15° C (59° F) and seldom above 35° C (95° F), the average yearly temperature varying between 19° C and 33° C (cf. Crampton, 1916). A lower temperature of from 1° to 3° C at sea level on the exposed coast is indicated by the few observations available as well as a drop of about 5° C for each thousand feet of elevation toward the interior (cf. Crampton, *loc. cit.*, p. 20). There is, however, no indication of snow on the higher peaks so that this estimate of rate of lowering is probably too high, especially for the higher altitudes. Orohena (alt. 7321 ft.) has not been scaled so far as reports inform us, but Aorai (alt. 6773 ft.) has been visited. No experience of excessive cold (i.e., near 0° C) is related, but I find no records of temperature actually taken. From the observations taken and the experience on Matafao on Tutuila (cf. Setchell, 1924), while the maximum may be 5° C each thousand feet of elevation, yet the average drop is more likely to be nearer 2° C.

The warmer months are those from September to March or April, while the cooler are those from May to August, but hot days or spells are often encountered in the cool season and the nights vary much in temperature.

With rainfall, as in the case of temperature, we have the Papeete records, published also in the official records (with gaps). Crampton has given the details (1916, p. 21) for the years from 1901 to 1905. The rainy season is ordinarily from about September to April and the

drier season from May until August, but varies according to the year. The annual rainfall itself varies from about 40 inches (approx. 1000 mm.) to over 130 inches (approx. 3200 mm.) and the hours of rain from 63 to 163. The figures available are for the leeward coast region or driest quadrant of Tahiti Nui. As Crampton remarks (*loc. cit.*, pp. 21, 22), in Hitiaa, on the windward side, rain falls at least three times as many hours per annum as at Papeete. Through the kindness of Professor Harrison W. Smith, I am able to print a table of rainfall differences between Papeete and Papeari for the year 1923. It may be noted from the table that this year 1923 yielded a moderate rainfall at Papeete and that Papeari, while receiving much more rain than Papeete, through moisture-laden trade winds passing the narrow and low isthmus of Taravao, yet is not strictly on the windward side and certainly receives much less rain than Hitiaa or Tautira.

TAHITI RAINFALL

1923	Papeete	Papeari
	<i>Millimeters</i>	
January	355 1	238 7
February	307 5	139 2
March	160 1	358 4
April	186 8	139 4
May	95 2	230 6
June	112 6	63 4
July	19 8	50 6
August	1 3	86 8
September	187 6	311 2
October	121 4	137 1
November	213 2	484 7
December	208 5	143 7
Total	1969 1	2383 8
	77 6 inches	93 8 inches

It must also be emphasized that the uppermost regions of the island of Tahiti are covered with clouds much of the time (Crampton says nearly every day from about 10 A.M. to at least 3 P.M.) and consequently the upper slopes and valley heads are receiving rain. From the slopes the water drains off quickly, but the upper valley heads receive enough to keep the valley rivers full, often to overflowing. Since all the valleys, especially above the lower levels, have little or no room for other than the stream bed, and progress must be by wading, sudden rains above are often dangerous. The valleys with their steep, often almost perpendicular sides, forming comparatively narrow clefts filled below with dense vegetation, retain the water and

humid air, and seldom become dry even during spells of dry weather. On the drier (leeward) quadrants the valleys are dry at low altitudes, becoming more and more moist or wet as the altitude increases, while on the moister quadrants (windward) the valleys are moist even from the entrances. These characteristics exert a powerful influence on the type of vegetation, especially as coördinated with altitude, as will be noted later on.

FORMATIONS

The land vegetation of Tahiti may readily be divided into three general sets of formations, according to whether it clothes the coastal plain, the exposed slopes and ridges, or is sunk in the depths of shallow or deeper valleys.

COASTAL PLAIN FORMATIONS

The formations of the coastal plain are largely secondary, either wholly or in part, since the area is limited and has been the seat of population for all time. Whether there was, at any time in the history of the island, any real distinction between the traditional "Lizard People" and the "Middle People" inhabiting the slopes and those inhabiting the coastal plain, is not readily to be determined, although there are indications possibly pointing to such a segregation. It is certainly true that various villages control the nearby valleys and use the products of Fe'i (*Musa Fehi*) and Citrus fruits and that they formerly had regulations, or at least customs, as to their care which latterly have fallen more or less into disuse.

The strand region, which often occupies much of the coastal plain, is characterized by such trees as *Cocos nucifera*, *Pandanus tectorius*, *P. tahitensis*, *Ficus prolixa*, *Barringtonia asiatica*, *Hibiscus tiliaceus*, *Thespesia populnea*, *Calophyllum Inophyllum*, *Erythrina variegata* var. *orientalis* (= *E. indica*), *Hernandia ovigera*, and *Cordia subcordata*. The last three species are now scarce, at least in the form of well-grown specimens, on the shores of Tahiti, where formerly they were at least common, but they have long been used for domestic and commercial purposes. *Barringtonia asiatica* is found only in a few localities. *Thespesia populnea* is by no means common, *Pandanus* is frequent, and while *Calophyllum Inophyllum* or "Tamanu" is common, comparatively few large trees are seen. Moerenhout (1837,

vol. 1, pp. 295, 296) tells of having received (in 1832) an order for a considerable amount of the wood of the "Tamanu" which had been planted particularly about the "marais," or sacred places. He found the trees of enormous size, thirty to forty feet high and up to six feet in diameter at the base, thus requiring extreme labor in the preparation for transport. He relates that, while cutting those on the Marai of Tati, Chief of Papara, the adjacent stream was reddened and the natives, not entirely free from their old superstitions and, as well, with their poetic sense, said that this was caused by the blood of the slaughtered trees. So far as I am aware, there are no such immense trees of "Tamanu" existing in Tahiti at the present day. *Erythrina variegata* var. *orientalis* (*E. indica*) was not met with, *Cordia subcordata* was seen only as young slender trees, and in fact few indigenous trees of the strand are of any considerable size. *Guettarda speciosa* we encountered only once, on the beach at Tautira, seemingly from seed cast ashore. The natives said that it came from the Tuamotu.

Along the strand in the district of Faaa, *Typha domingensis* has become established in a protected locality and has spread over a considerable area, forming a striking secondary formation. This was along a muddy shore, but mangroves which might be expected in such a locality were absent and were not detected on any part of the Tahitian coast, a feature already remarked upon by Guppy (1906, vol. 1, pp. 47, 48). Guppy also calls attention to the fact that plants usually occurring with a mangrove formation are also absent from Tahiti. At protected places along the strand, in muddy shallow waters, *Hibiscus tiliaceus* forms a complicated thicket, with descending, curved branches, seemingly rooting and forming stilt-like supports for the mass of branches above and thus extending out over shallow areas, simulating the habit of a mangrove formation.

On the sandy portions of the strand are found *Ipomoea pescaprae*; on the high portions of the beach and higher still, prostrate associations of *Canavalia microcarpa* and of *Vigna marina*, the latter generally climbing over bushes and festooning tall trees, or even mounting to the slopes and cliffs beyond the coastal plain.

At certain places along the coast of Tahiti, especially on the low coral-sand islets along the barrier reef or inside, there occurs a flora more especially characteristic of atolls, such as those of the Tuamotu group. These species are rarely met with and possibly are of occasional introduction and evanescent. Such species are *Tournefortia argentea*, *Lepidium piscidium*, *Pemphis acidula*, *Sophora tomentosa*, etc.

On the flat, low portion of the coastal plain, the strand flora continues inward as far as the soil is made up chiefly of coral sand, becoming more and more mixed with species requiring a less calcareous soil and one richer in plant food farther inland. In this portion of the coastal plain, in the mouths of the valleys, and up to the cliffs or lower portions of the steep slope, are situated various formations, mostly secondary, but more or less altered primary formations may also be seen. Owing to the decrease in the native population, much less of the area in the valleys above the coastal plain, formerly occupied, or at least cultivated, is now either occupied or cultivated, and culture in general is largely restricted to the coastal plain itself or to the mouths of a few of the larger valleys.

The principal crops are coconuts, sugar, green vegetables, yams, sweet potatoes, bread fruit, and coffee. The first is practically the only crop used for trade, copra being the main article of commerce with the outside world. The other crops are local and often individual. Most families raise their own coffee. For fruits, mangoes, avocados or alligator pears, vi-apples (*Spondias dulcis*), and bananas are the principal ones seen on the coastal plain. Citrus fruits and plantains or Fe'i are obtained from old and now much neglected plantations in the valleys, although the former are said to have been grown on the coastal plain until blotted out by disease. Vanilla was at one time a profitable crop, until overtaken by a disease, but now seems to be increasing in importance. Formerly Polynesian arrow root (*Tacca pinnatifida*) was extensively cultivated, in very simple fashion (cf. Moerenhout, 1837, p. 225), but this seems to have greatly decreased. The cultivation of taro does not seem at present to be at all common. The consumption of bread has increased but it is not made by the inhabitants generally. Bread carts, operated by Chinese, proceed from Papeete to all parts along the roads which nearly encircle the island. Payment for the bread is made either in money or, by the native, in copra, vanilla, or some such commodity.

The vegetable gardens are owned and worked by Chinese and afford variety to the diet of the inhabitants of Papeete. The Chinese supply the yams, sweet potatoes, and bananas, although these are also raised to some extent by the natives. In a swampy place near a Chinese garden I noted a few plants of what appeared to be a *Sagittaria* (possibly *S. sagittaeifolia* L.) but it was not in flower. It is noted since the Chinese often cultivate one or more species of this genus.

Of secondary formations in the coastal plain, none is more conspicuous than that of the shade trees. These are clustered about houses on ornamental grounds and along streets and roads. They form a sort of secondary formation of considerable size. Foremost in age and size come stands of *Samanea Saman*, especially about the principal streets of Papeete, then of *Delonix regia*, *Inga edulis*, *Albizia Lebbek*, *Tamarindus indica*, *Bauhinia indica*, *B. variegata*, *Pithecolobium dulce*, *Araucaria* (of several species), *Tectonia grandis*, *Melia Azederach*, *Ceiba pentandra*, *Stenolobium stans*, *Terminalia Catappa* (always seen planted), *Eugenia Jambos*, *E. Cumini*, *Eucalyptus creba* (and probably other species), *Thevetia peruviana*, *Plumeria acuminata*, and many others. The desirability of deep shade about the houses and along streets and roads has lead to the introduction of these and other exotics.

The list of ornamental shrubs, if it could be made approximately complete, would be very considerable. I can only mention the more common, such as *Hibiscus rosa-sinensis* and its hybrid varieties, *H. schizopetalus*, *Murraya paniculata*, *Breynia nívosa* (in hedges), *Codiaeum variegatum* (in various color forms in hedges), *Eugenia Micheli*, *Nothopanax Guílfoylei* (in hedges), *Nerium indicum*, *Tabernaemontana divaricata*, *Lochnera rosea*, *Allamanda cathartica*, *Bougainvillea spectabilis*, *Cestrum diurnum*, various species of *Ixora*, *Acalypha Wilkesiana*, *A. Godseffiana*, and many others.

Among secondary formations may be classed those containing ornamental herbs, especially bulbous plants such as *Crinum asiaticum*, *Eucharis grandifolia*, etc. Very little attention, however, could be paid to these plants. *Corculum leptopus*, an herbaceous climber, was frequent as well as attractive, and *Gomphrena globosa* was, as might be expected, more or less a favorite.

Two climbing Aroids are cultivated, *Monstera deliciosa* and *Scindapsus aureus*. Among the cultivated areas, or even in them, occur certain plants supposedly indigenous. Such plants are *Cocos nucifera* (extensively planted), *Ficus prolixa*, the banyan, often near ruins of marais, *Gardenia taitensis*, which although long associated with Tahiti seems always to have been cultivated and may have come from Samoa (cf. Setchell, 1924, p. 48). The "Vi" (*Spondias dulcis*) is another supposedly indigenous plant which is always planted. Various kinds of taro (*Colocasia esculentum*, *Alocasia macrorrhiza*, *Cyrtosperma Chamissonis*) partly indigenous or of aboriginal introduction, together with varieties of recent introduction, are always cultivated. *Ter-*

minalia Catappa, credited as being indigenous, I have seen only when planted, as it is frequently, as a street tree.

On the flat, low portion of the coastal plain, primary formations occur only in swampy lands or on muddy shores. In the swampy areas, never of very large extent, one finds *Polygonium glabrum* and *Jussiaea repens*, together with associations of moisture-loving *Cyperaceae*, both of indigenous and of introduced species.

The weed flora of Tahiti is extensive and troublesome. It is confined to the coastal plain and the floors of the larger valleys ascending the lower slopes to only a slight extent. Of shrubs, there may be mentioned particularly *Lantana camara* and *Psidium Guajava*, each forming thickets on the coastal plains and valleys and even extending in some places a little way up the slopes. These are by far the most troublesome weeds of Tahiti. Along roadsides may be found a number of leguminous shrubby weeds, e.g., the low *Mimosa pudica* and *Cassia occidentalis*, and the taller *Acaria Farnesiana* and *Leucaena glauca*. Of stouter or more slender suffruticose or herbaceous weeds there are many, e.g., *Commelina nudiflora*, *Achyranthes aspera*, *Portulaca oleracea*, *Polanisia icosandra*, *Bryophyllum pinnatum*, *Crotalaria Saltiana*, *C. verrucosa*, *C. sericea*, *Indigofera suffrutescens*, *Aeschynomene indica*, *Desmodium triflorum*, *D. incanum*, *Clitoria ternata*, *Phaseolus lathyroides*, *Oxalis repens*, *Phyllanthus Niruri*, *P. simplex*, *Ricinus communis*, *Euphorbia hirta*, *Cardiospermum Halicababum*, *Corchorus acutangulus*, *Triumfetta Bartramia*, *Wissadula amplissima*, *Sida acuta*, *S. spinosa* var. *angustifolia*, *Urena lobata*, *Hibiscus vitifolius*, *Passiflora foetida*, *Jussiaea erecta*, *Merremia umbellata*, *Ipomoea dissecta*, *I. gracilis*, *I. obscura*, *Cuscuta pentagona*, *Stachytarpheta jamaicensis*, *Leonurus sibiricus*, *Salvia occidentalis*, *Colias Blumei*, *Ocimum gratissimum*, *Physalis lanceifolia*, *Capsicum frutescens*, *Momordica Charantia*, *Vernonia cinerea*, *Elephantopus mollis*, *Ageratum conyzoides*, *Xanthium strumarium*, *Synedrella nodiflora*, *Bidens pilosa*, *Emilia sonchifolia*, and *Sonchus oleraceus*. Some of these are not abundant as yet but the great majority of them are altogether too common. About waterways one finds an occasional association of *Eichornia crassipes*. It is noticeable that the majority of wayside and field weeds occur in the districts of Pari, Arue, and Faaa, particularly in the last. These districts are nearest to Papeete, the only port of entry for French Polynesia. The two most troublesome of the herbaceous weeds are *Elephantopus mollis* and *Bidens pilosa*.

In an approximate estimate I find that there are credited to the Island of Tahiti about 330 species of Spermatophytes, occurring either as indigenous plants or probably introduced earlier than Cook's first voyage (1769) and 158 species of Pteridophytes. Of these plants, not counting species clearly of introduction after 1769, I find that the coastal plain, lowermost slopes, and mouths of valleys have 137 species of Spermatophytes and 3 species of ferns assigned to them. My own experience indicates the approximate correctness of this proportion.

FORMATIONS OF THE LOWERMOST SLOPES

The lower slopes in the dry sectors have little other than *Lantana* or *Guava* thickets or are clothed, as are the slopes higher up, with close and impenetrable thickets of *Dicranopteris linearis*. In the moist or wet sectors, the lower cliffs and slopes, particularly in gullies, have a distinct shrub or forest formation, resembling to some extent those of the upper valleys. One finds *Hibiscus tiliaceus*, *Inocarpus edulis*, *Angiopteris evecta*, *Cerbera manghas*, *Aleurites moluccana*, *Ficus tinctoria*, and localities in such situations are to be seen where *Santalum Freycinetianum* was wont to grow before its practical extinction.

On dripping cliffs in shade one finds occasionally *Freycinetia demissa*, not far above sea level. In moderately dry sectors are found *Wikstroemia foetida* var. *tahitensis* and in moist spots *Piper latifolium*, *Lygodium reticulatum*, *Colubrina asiatica*, *Glochidion rami-florum*, *Jasminum didymum*, etc., while in the moist sectors are found *Plectronia barbata*, *Melastoma denticulatum*, *Crossostyles biflora*, *Homalanthus Moerenhoutianus*, *Premna taitensis*, etc., which otherwise occur only high up in moist valleys in the drier sectors.

FORMATIONS OF THE MIDDLE SLOPE BELT (XEROPHYTE)

Above the coastal plain with its secondary formations and above the lower slopes whose primary formations may be forest, shrub, or undershrub, according to their relation to the moisture-laden trade winds and resultant precipitation, and consequently more xerophyte or more mesophyte (or even hydrophyte), the Island of Tahiti shows exposed slopes and ridges interrupted by the deep radiating valleys. The exposed slopes, ridges, etc., of middle elevation are fairly uniformly clothed with a single undershrub formation, viz., that formed by a nearly pure pteridophyte association of the common "*Gleichenia*

dichotoma," now generally called *Dicranopteris linearis*. The dichotomous, wiry climbing stems of this species intertwine and form a dense thicket, even up to ten or more feet high, through which a way must be beaten or cut if one desires passage. It forms a truly xerophyte formation up to about 5000 feet altitude, relieved by bare stony outcrops or associated with scattered individuals or clumps of *Dodonaea viscosa* or *Metrosideros collina* (two varieties), the former only an undershrub but the latter rising, especially in a slight swale or gully, to the dignity of a tall shrub or even becoming a tree under favorable conditions. Of recent years there has intruded on this monotonous *Dicranopteris* belt which gives the appearance of "verdure" from the distance, a shrub growing even to be a tree, viz., *Stenolobium stans*, the "Yellow Elder," a native of Atlantic tropical America and cultivated in Tahiti as an ornamental since about 1845. The winged seeds are caught by the upward current of air and, as has been described to me by a mountain climber of this region, at 5000 feet up on Mount Aorai, they are to be seen still sailing upward. The Yellow Elder seems well adapted to the xerophyte conditions of the slopes above the coastal plain of the drier sectors and literally armies of young trees are seen ascending these slopes, being established up to 3000 feet or even higher. On the middle slopes are larger or smaller swales or gullies and in such occur small groups of shrubs or trees, but these are properly of the Tahitian valley type of formation.

FORMATIONS OF THE UPPER BELTS

The slopes above 5000 feet are little known, but according to such scanty information as I have been able to gather from Mr. Ernest H. Quayle, who determined his altitudes at least fairly approximately by barometric readings, the formation is still undershrub, becoming less continuous, less compact, and more prostrate as the elevation increases. The main components of the formation of this belt are *Lycopodium cernuum* and another species, *L. volubile*, xerophytic pteridophytes uncommon at lower altitudes; the former is found nearly down to the coastal plain though, near sea level, it occurs only in depauperate form. On this same belt Mr. Quayle also collected a variety of *Styphelia* (*Cyathodes*) *Tameiameae*. (I am indebted to the B. P. Bishop Museum of Honolulu through Dr. Forest H. B. Brown for specimens of these various plants collected on Aorai by Mr. Quayle.) Dana (1849, pp. 290-292) gives some details of his climb to the top of

Aorai and makes some reference to the formations of the lower and middle slopes, mentioning the "wiry brake ('*Gleichenium*') which grows to a height of 10 feet and is almost impenetrable." Moseley in the Narrative of the Voyage of the Challenger (1885, pp. 783-788) also gives us hints as to the vegetation from sea level to the top of Aorai (nearly 7000 ft. alt.). On the crest of the ridge (about 4000 ft. alt.) the party found "a thick growth of the fern (*Gleichenia dichotoma*) and a climbing fern (*Lygodium*), and amongst the bushes on the ridge a whortleberry (*Vaccinium*) was very abundant, with two species of *Metrosideros*. The entire vegetation was different from that down below" (i.e., in the Punaruu Valley). At about 4000 feet the way of Moseley's party was brought to a halt by a precipice, the "crest widened out and here there was a damp hollow with mosses and lichens in great abundance." "Here also grew a tree (*Fitchia nutans*), 20 feet in height and with a trunk 9 inches in diameter, belonging to the Compositae, with a large yellow flower."

It is of the floral inhabitants of these upper ridges and swales, from 4000 to 5000 feet up, that information is scanty, but most desirable. *Fitchia nutans* undoubtedly grows in the moist swales of this upper region. We may presume that *Sclerotheca arborea* and *S. Forsteri* also grow in similar situations (cf. Drake del Castillo, 1893, p. 114). Possibly the two endemic species of the Epicridaceous genus *Cyathodes* (*Styphelia*) also inhabit such high moist localities (cf. Drake del Castillo, 1893, p. 116). One is impressed when looking over Drake del Castillo's account (1893) by the fact that the more distinctive plants of Tahiti are practically all recorded (by the collectors) from considerable elevations. These are the upper swales or heads of valleys and I shall refer to them later on.

FORMATIONS OF THE VALLEYS (MESOPHYTE)

The mouths, or lowermost portions of the valleys, show a continuation of the more or less mesophyte flora of the coastal plain or of the lowermost slopes, and, especially in the drier sectors, this may continue to the height of 1000 or more feet. In the rainy sectors, however, the mesophyte valley flora may generally be found much lower, in some cases almost to sea level (e.g., Maara Valley, Valley of the Vaitepiha River, etc.). On the drier side the distinctly mesophyte flora begins anywhere from 1000 to 1800 feet altitude and continues up to 3000 feet or more, being situated on the steep slopes or cliffs of the valley

walls, one of the characteristic and determining species being the tree fern, *Cyathea affinis*. From a very few feet above sea level on the moist sectors and from 1000 to 1800 feet on the drier sectors, up to about 3000 feet on all sectors (so far as data are available) is to be found the bulk of the characteristic indigenous species of land plants of Tahiti. The experience of our party did not extend beyond an altitude of 3000 feet, but from the experiences of Dana and Moseley (referred to earlier in this account) and from conversations with the few who had climbed Aorai, particularly with Mr. Ernest H. Quayle, and from the data of Vesco Nadeaud, and as recorded by Drake del Castillo, there is probably a marked difference between the valley mesophyte flora and that of the heads of the valleys and uppermost swales. The region of transition must be somewhere between 2500 and 3500 feet elevation. From the valley formations as thus distinguished, there are recorded approximately 216 species of spermatophytes and 118 of pteridophytes, or 334 species of vascular plants. Here are to be found characteristic trees, epiphytes (including orchids and ferns), parasites, such as *Belanophora pallens*, *Viscum articulatum*, *Loranthus Forsterianus*, the peculiar species of *Peperomia*, *Piper*, *Elatostema*, *Langeveldia*, *Ophiorrhiza*, *Psychotria*, *Ixora*, *Celtis*, etc. Pteridophytes are most abundant in these, the deeper portions of the valleys, such as the huge *Angiopteris*, the tree fern *Cyathea affinis*, the climbing *Stenochlaena Setchellii*, *Lomogramma Wilkesiana*, also a climber and with variably pinnated leaves, *Ophioderma pendulum*, *Lycopodium Phlegmaria* in quantity, the huge bunches of *Vittaria* drooping from trees or from rock crevices, *Psilotum*, *T. mesipteris*, *Selaginella*, etc. The Hymenophyllaceae are, however, mostly small and inconspicuous, although at times occurring in quantity. Many endemic species occur in the lower portions of the deep valleys.

Of secondary formations may be mentioned Citrus associations and those of Fe'i (*Musa Fehi*). I was told that the Citrus species formerly flourished on the coastal plain but succumbed to disease. The usual source of oranges and limes is, at the present time, the old trees in the lower portions of the deep valleys. The oranges are gathered by native vendors or by Chinese and brought into Papeete in quantity. They are usually juicy and pleasantly sweet. As I have stated (Univ. Calif. Publ. Bot., vol. 12, pp. 143-240, 1926), it is not improbable that the trees, now yielding such delicious fruit, may be the descendants of those introduced in 1769 by Sir Joseph Banks, who obtained his seed

in Brazil. The Fe'i (*Musa Fehi*) presents a most puzzling and interesting botanical problem. I have spoken of its associations as secondary. I have done this because, so far as I was able to learn, its reproduction is entirely by vegetative offshoots. It grows scattered but in small groups at about 1500 to 2500 feet altitude on the drier sectors, but descends to within 100 feet of sea level on the moister sectors. Natives proceed up the various valleys, each valley under the control of the nearest village, pull down the trees, cut off the erect, usually heavily laden fruit mass and bring down their cargo from steep, often almost inaccessible slopes or cliffs to the villages and to Papeete for home consumption or for sale. The Fe'i, having firm, hard flesh, must be baked or roasted to be eaten. In recent days the village control of Fe'i patches has relaxed and former precautions for assuring a continuation of the supply are partially or wholly neglected. As a consequence, the "Fe'i man" must ever go higher and into the less accessible portions of the valleys for his crop. This lack of attention usually results in the overrunning of the Fe'i patches by the tough, coarse, shrubby vines of *Freycinetia demissa*, to the point of extinction of the Fe'i. A few natives are now cultivating the Fe'i with success.

One of the matters concerning Fe'i in connection with its possible origin is the fact that it shows a considerable number of kinds. I have been able to examine or obtain descriptions of some fourteen or fifteen distinct varieties or races. To place my results on record I have given each recognized Fe'i its native name, under the account of *Musa Fehi*, in my Tahitian Spermatophytes (Univ. Calif. Publ. Bot., vol. 12, pp. 143-240, 1926). While there is a variety of opinion as to whether the Fe'i ever produces seeds, and while it is true that certain varieties, at least, produce the "iriiri" or "stones," there is nothing except hearsay to show that these "iriiri" ever contain embryos. Dr. Nadeaud is said to have succeeded in germinating some. The Fe'i plant, then, with annual flowering stems, depends absolutely on vegetative reproduction (stolons) for its perpetuation.

While other secondary formations have intruded into portions of valleys, here and there, the Citrus association is the only one clearly belonging under this head, with the Fe'i association having some claims also to be included.

VALLEY HEAD AND SWALE FORMATIONS

We can only catch glimpses of the flora of the upper regions of the mountains of Tahiti from the accounts of a few writers. For the almost uniform clothing of the slope proper, we learn something from Dana's account (1849, p. 291). He speaks of numerous bushes along the narrow ridge leading from the 5000 foot level up to the peak of Aorai. They may have been *Cyathodes* (*Styphelia*) or a *Myrsine* or a *Glochidion*, or some one of the suffrutescent or frutescent higher forms, but possibly they were, for the most part, a high mountain form of *Metrosideros collina*. Moseley (1885, p. 783) did not reach an altitude much over 4000 feet, but he has left us some exceedingly valuable though scanty notes of the conditions at that height. He says: "Here there was a damp hollow with mosses and lichens growing in it in great abundance." "Here also grew a tree (*Fitchia nutans*) 20 feet in height, and with a trunk 9 inches in diameter, belonging to the Compositae and with a large yellow flower." From this and from what we know of the situation farther down, it seems proper to assume that the great majority of the species credited to heights above 3000 feet grow in larger or smaller, shallow but moist depressions, or, as I have designated them, swales. Of the 330 species of Spermatophytes credited to Tahiti, at least 25 are probably characteristic of these higher altitudes and probably of such moist hollows; and of the 158 pteridophytes, at least 25 species seem to occur in the same altitudes and probably for the greater part, at least, in the same sort of localities. Practically all of these species are endemics. It may be worth noting here that Moseley (*loc. cit.*) observed that it was in such places that far-ranging birds such as "Burrowing Petrels, Puffins, and Tropic Birds," nest.

Nadeaud in his *Enumeration des Plantes de l'île de Tahiti* (1873, pp. 3, 4) has some observations on the distribution of the flora of Tahiti into belts and sectors. Nadeaud's acquaintance with the flora of all parts of the island was unrivaled, and it is to be regretted that he did not give more detail of his experience of the floral regions. He speaks of the distinct limitations of the zones as one proceeds from the shore to the summits of the interior. He especially mentions the zones of *Spondis dulcis*, of the arborescent ferns, and of *Musa Fehi*. He also calls attention to the fact that the limits of these zones are modified by three sets of "causes": (1) the temperature of the interior

is greatly below that of the marine climate of the shore and consequently a species whose lower limit is 1000 meters altitude near the shore is 600 meters or less away from it; (2) the center of the island being occupied by the high mountains where the clouds collect, the plants receive more rain than those of the littoral, experience more abrupt changes of temperature between day and night, and are subject more frequently to dews, conditions which favor vegetation over that of the lower hills; and (3) the southeast trades, by the rain and the lower temperatures they bring with them, cause the sectors coming within their influence to be more luxuriant at a lower level and cause vegetation which exists only at a high level on the dry sectors to descend almost to sea level in the sectors exposed to them. It seems that Nadeaud had the valley and swale floras chiefly in mind.

SUCCESSION

The various formations noted briefly above may probably be regarded as climax formations, or at least as representing the highest type of formation for each belt under present edaphic and climatic conditions. So far as I may judge from my inadequate experience the vegetation of the slope region above the coastal belt is to be divided into a xerophyte and a mesophyte formation, the former characteristic of the slopes, even of the higher region, since the slope and edaphic conditions are such as not to retain moisture. The latter or mesophyte formation, in the depths of the valleys or more exposed portions above, being able through their differences in relief, to retain more water in the soil or to maintain a more humid atmosphere, or both. The moisture factor seems therefore to be the more pronounced, although the influence of the temperature factor seems likely to be associated with it, as Nadeaud has pointed out.

The suggestion occurs, however, that edaphic changes, in connection with changes of relief, may in time convert the whole of the slope into swales and valleys with few exposed ridges, and a forest climax formation may at some time cover a far greater portion of the island than it does now. The rainfall throughout the island is sufficient so that there is no such extreme dearth of rain on the dry sectors as is to be found in some Polynesian islands, e.g., those of Hawaii. It seems, therefore, that the present condition of the vegetation indicates, as do the geological features, that Tahiti is one of the younger of the high islands of the Pacific Ocean.

NOTES ON FLORISTIC DISTRIBUTION

The floristic distribution of the vascular plants has been discussed, particularly by Drake del Castillo (1890—accessible to me only in abstract form) and by Guppy (1906). Drake knew the flora directly from herbarium materials and from the notes of the collectors, while Guppy, with wide experience in Polynesia, obtained his data concerning the flora of Tahiti chiefly from Drake. My own experience of the flora of Tahiti does not include any contact with the higher regions (i.e., above 3000 feet) and I can add little from my own observations of it except in general as observed below this altitude or general impressions as to the higher vegetation obtained by the help of a pair of excellent binoculars.

STATISTICS OF THE FLORA

Nadeaud in his Enumeration (1873) considers as indigenous some 507 species. These are divided as follows:

Spermatophytes	289
Pteridophytes	127
Bryophytes	91

Nadeaud enumerates neither the mycophytes nor phycophytes, of which very few were known.

Drake del Castillo in his Flore de la Polynésie française (1893) gives for Tahiti itself about 370 species of indigenous spermatophytes distributed through over 230 genera, and about 150 species of pteridophytes under 38 genera.

The recent papers of Forest B. H. Brown (1921, 1922), D. H. Campbell (1919), and Carl Skottsberg (1925) make no allusion to the Tahitian flora and its relations. In view of the strategic position of Tahiti (together with the Marquesas Islands and with Rarotonga), it seems best to bring forward such points in the floristic distribution as have appealed to the writer as being of importance, especially in connection with the topographic distribution, both being considered as far as is possible from the ecologic standpoint.

Guppy (*loc. cit.*, p. 323), after rigidly revising the lists and eliminating all species introduced either by the earlier aborigines or after European visits began, estimates the number of species of spermatophytes

phytes as 315 and those of pteridophytes (*loc. cit.*, p. 222) as 154, these latter constituting about 33 per cent of the entire vascular flora. Since 1893, the date of publication of Drake del Castillo's *Flore*, Nadeaud (1897 and 1899) has added twelve spermatophytes and two pteridophytes, all endemic to the Society Islands and to Tahiti except one species of spermatophyte. These do not seem to have been included by Guppy in his list. Maxon (1924), working over the pteridophytes of our collection, adds four species, all endemic. The estimate as finally revised should read: spermatophytes 330, pteridophytes 158, and the latter still constituting about one-third of the entire vascular flora. Of these vascular plants about 127 spermatophytes are endemic to Tahiti, or at least to the Society Islands (slightly over 20 per cent) and 17 pteridophytes (slightly over 9 per cent). A thorough working over of the specimens of the vascular flora already collected and particularly of those of the ferns (see Maxon, 1924, p. 17) will probably increase both the number of species and the proportion of endemics, particularly the latter. More extensive exploration of the higher regions (accessible with difficulty) will probably add much that is peculiar. The figures of Guppy, as amended, show sufficiently approximate figures and percentages to form a reasonable basis for discussion.

Of the flora of the rest of the Society Islands, few data are available. They are all much lower than Tahiti, approximating little over half its altitude, and are also probably somewhat older so far as vegetation is concerned. So far as may be ascertained from the various accounts, the flora of each of these islands and the Marquesas group have recorded species as follows:

	Spermatophytes			Pteridophytes			Total of vascular plants		
	Species	Endemic	In common with Tahiti	Species	Endemic	In common with Tahiti	Species	Endemic	In common with Tahiti
Tahiti	330	127	330	158	17	158	488	144	
Moorea	20	6	14	13	0	13	33	6	
Huahine	1	0	1	1	0	1	2	0	
Raiatea	1	1	0	3	0	3	4	1	
Borabora	9	1	8	2	0	2	11	1	
Society group	368	135		158	17		526	152	
Rarotonga							235	18	167
Marquesas*	129	14	96	9	0	9	138		105

* The figures for the Marquesas are taken from Drake del Castillo's *Flore* (1893) and indicate how little is known of the flora of these islands except that in general the flora of the lower altitudes is probably very similar to that of the same levels in Tahiti. The Rarotonga figures are from Cheeseman (1903).

The table just outlined shows the relationship of the Tahitian to the known floras of the adjacent islands or archipelagoes. With the exception of the last, the accounts are extremely far from complete. The meager records from the Society Islands other than Tahiti render it impossible to treat the group as a whole. Each island doubtless has its endemics, but we have only the striking endemic Lobelioid (*Apetahia raiatensis*) of Raiatea and the comparatively recently described new species from Moorea (Nadeaud, 1899), including the new and seemingly endemic genus *Hitoea* (Rubiaceae). Comparison cannot, therefore, be instituted between the Society group, as a group, and other groups. What we know of the flora of Tahiti, together with the few hints from Moorea, Raiatea, and Borabora, may be used tentatively.

The flora of the Society group has much in common with that of the other high islands which stand as the outposts of eastern Polynesia. It may be presumed, from what we know, that the Society Islands, the Marquesas Islands, and Rarotonga resemble one another closely in the general features of their floras and even have a considerable proportion of their families, genera, and even species in common. The Marquesas, judging from their lack of coral reefs, may be much younger from the point of view of the age of their vegetation than any of the Society group; and Raratonga, also from this point of view, may be compared to the reef-encircled islands of the Society group. The differences between these three groups may be found greater than is at present to be suspected, especially when the results of recent exploration of the Marquesas become available. In attempting to make any comparison between the high islands of the Society group and those of other groups and to establish a basis for discussion of the flora as to possible origin, it seems most profitable to follow the fashion so well set forth by Skottsberg (1925) and analyze the various groups and elements recognizable in the flora of Tahiti and of other islands of the Society group in so far as this may be possible.

In tabulating the species credited to the Society Islands and revising, so far as is possible without attempting to monograph the material upon which the determinations are based, I find that there are approximately 361 species of spermatophytes and 167 species of pteridophytes representing the flora of the islands at the time of the earlier visitation by Europeans. These figures include species of possible aboriginal introduction, whether voluntary or involuntary. The total number of vascular plants is, therefore, considered to be 528.

PANTROPIC GROUP

There are credited to the Society Islands 65 species of spermatophytes, or 18 per cent of the total number, which are pantropic. There are also credited 20 pantropic pteridophytes, or somewhat over 12 per cent of the total number. These two assignments total 85 species of pantropic vascular plants, or 16 per cent of the total number. While there might be discussion as to the probability of some of these being derived rather from the neotropics than from the paleotropics, the likelihood from the point of view of what follows seems more in favor of a paleotropic derivation. I have not included in this element, however, a few species such as *Luzula campestris*, *Pteridium aquilinum*, *Polystichum aculeatum*, etc., probably of boreal origin. It seems most likely, however, that they arrived by way of the paleotropics. Even in the case of the boreal species mentioned, it seems likely that they also migrated from Asia, since in the case of *Polystichum aculeatum*, at least, it is the Malayan form which is accredited to Tahiti. I suggest, therefore, that 16 per cent of the flora under consideration has been derived directly from the paleotropics and mostly, if not entirely, from the Indo-Malayan region.

PALEOTROPIC GROUP

Among the species credited to Tahiti and the rest of the Society group of islands are 66 species of spermatophytes or somewhat over 18 per cent of the total number, and 79 species of pteridophytes or over 47 per cent of the total number which are paleotropic. These together amount to 145 species or slightly over 27 per cent of the total number of vascular plants attributed to the islands. The great majority of these species are otherwise limited to the Indo-Malayan region, but a fair number are wider in their distribution in the tropics of the Old World. The paleotropic element added to the pantropic element totals 265 species of vascular plants or nearly 44 per cent of those credited to the Society Islands.

NEOTROPIC GROUP

The distinctly traceable neotropic element is small, consisting of three species of spermatophytes or somewhat over one per cent of the total number, and one species of pteridophyte or slightly over one-half of one per cent of the total; or combined, of four species, or not quite one per cent of the total number of vascular plants.

The single pteridophyte, *Marsilea polycarpa*, is not mentioned in Drake del Castillo's account, but Alexander Braun (1871, p. 659) says that it is clearly the South American species.

AUSTRALIO-NEW ZEALAND GROUP

Some seven species of spermatophytes and fourteen species of pteridophytes, or nearly four per cent of the vascular plants of the Society group, occur also in Australia or New Zealand or both. In attempting to analyze this group, we may segregate all but two species of spermatophytes, viz., *Dianella intermedia* and *Coriaria ruscifolia*, both extending into New Zealand and the latter also into South America, as of tropical Australia and probably of paleotropic affinities. The two species mentioned may be considered later on with certain species of Antarctic affinities. Of the fourteen species of pteridophytes included here, some also extend to tropical Australia or even northern New Zealand and may be considered to be of paleotropic affinities. Most are to be placed with the Antarctic species.

POLYNESIAN GROUP

Of the species, not endemic, but confined to Polynesia, there are credited to Tahiti and the Society Islands 71 species of spermatophytes or nearly 20 per cent of the total number, and 26 pteridophytes or over 15 per cent of the total number. United, we find in this group 97 species of vascular plants or somewhat over 18 per cent of the total.

Of the 97 species assigned to the Polynesian group of non-endemic species of the Society Islands, some are clearly of paleotropic relationship but others seem clearly subantarctic in their affinities, while a few others are either boreal or possibly neotropic in their affinities.

ENDEMIC GROUP

The endemic genera and species of Tahiti cannot be considered without some reference to those of the other islands of the group and to those of other groups of islands of eastern Polynesia, viz., the Marquesas, Tuamotu, and the Island of Rarotonga. This is particularly to be emphasized in the case of genera. The genera in question are *Fitchia* (Compos.), *Sclerotheca* and *Apetahia* (Campan.), *Lepinea* (Apoc.), *Hitoea* (Rub.), and perhaps *Moerenhoutia* (Orchid.). *Titchia* is represented in both Tahiti (3 species) and Rarotonga (1 species). *Sclerotheca* is represented in both Tahiti (2 species) and Rarotonga (1 species). *Apetahia* is not known on Tahiti but is endemic in a single species on Raiatea, another of the Society Islands. *Lepinea* is endemic in a single species on Tahiti. *Hitoea*, proposed for a single species from Moorea, adjacent to Tahiti, is said to be closely related to *Ixora* and *Myonima*. *Moerenhoutia*, established for a Tahitian species, is said to have a second species in Samoa. Of these endemic or subendemic (so far as the Society Islands are concerned) genera, *Fitchia* stands among the Cichoriaceous genera of the Compositae in an extremely isolated position because of its arboreous habit and its peculiar achene. From *Dendroseris*, the only other arboreous Cichoriaceous genus, it differs in the abbreviated connate stigmatic lobes and its two-awned achenes. The Lobelioid genera, *Sclerotheca* and *Apetahia*, are to be associated with the endemic Hawaiian genera as representatives of an element whose source is unknown but which, together with the arborescent Lobelioids of the Andes and of the mountains of Central Africa, may have been derived from southern latitudes under conditions no longer existing, but probably earlier permitting of northward migration. Skottsberg's arrangement (1925, p. 7) of these plants with his "Old Pacific Element" and this element possibly originating from the Tertiary flora of the Antarctic Continent (Skottsberg, 1925, p. 45) is the most suggestive hypothesis as yet put forward. A similar suggestion may be made as to *Lepinea*, whose nearest relatives seem to be Australian and West African genera. The genus *Moerenhoutia*, on the other hand, seems to be fairly closely related to Indo-Malayan genera. *Hitoea*, if it is a good genus, is certainly also of Indo-Malayan affinities.

Of endemic or semi-endemic species, there are described from the Society Islands 147 spermatophytes, or nearly 41 per cent of the

total, and 25 species of pteridophytes or nearly 15 per cent of the total, making 172 vascular plants thus designated, or decidedly over 32 per cent of the whole number. Of the endemic species (other than those belonging to the endemic genera considered in the foregoing paragraph), *Byronia tahitensis*, *Gahnia schoenoides*, *Coprosoma tahitensis*, *Astelia Nadeaudii*, *Meryta lanceolata*, *Phyllostegia tahitensis*, *Ptychosperma tahitensis*, and *Styphelia* (*Cyathodes*) *Pomarae*, etc., seem clearly Old Pacific and probably of southern origin while *Weinmannia parviflora* seems possibly of American affinities, but possibly also from southern latitudes. The remaining endemics are largely, if not entirely, of paleotropic affinities.

SUMMARY OF VASCULAR PLANTS

Species	Society Islands		Indo-Malayan affinities		Antarctic affinities		Boreal affinities		Neotropic affinities	
	Sperm	Pterid	Sperm	Pterid	Sperm	Pterid	Sperm	Pterid	Sperm	Pterid
Pantropic	65	20	65	20						
Paleotropic	66	79	66	79			2	2		
General	2	2								
Polynesian	71	26	63	10	7	15	1			1
Endemic	147	25	112	23	32	2	1		2	
Australio-										
New Zealand	7	14	4	4	3	10				
Neotropic	3	1							3	1
Total	361	167	310	136	42	27	4	2	5	2
Total	528		146		69		6		7	
Percentage	100		85		13		1		1	

The estimates of the floral groups given above are of course faulty, the limits of error along several lines being large. The general trend of the analysis, however, is probably correct; i.e., that the direction of migration to the Society Islands has been eastward and the lands from which or through which the supply has been received now lie to the northwest and southwest, to some extent, but more particularly a little north of west. Contributions from the continental masses lying in the general easterly direction have perhaps been underestimated but seem to be largely negligible. Effective immigration from southern latitudes has been less than seems possibly to have been the case of both the Hawaiian and the Juan Fernandez Islands (cf.

Skottsberg, 1925, p. 6) but possibly this may be due largely to the unfavorable conditions for establishment ("ecesis") and persistence. To this and to matters of the influence of possible different ages of the groups as vegetational centers, I shall return briefly later on.

ETHNOBOTANIC ELEMENT

The additions to the plant population of Tahiti in connection with human occupation are considerable. I have eliminated from my estimates all those plants clearly and certainly adventive since the islands were first visited by Europeans. Previous to 1769, however, there were undoubtedly brought in, or found their way to the islands, a fair number of species both useful and otherwise. Cheeseman (1903, p. 269) has estimated the number of these species, the ethnobotanic element, as 19 for Rarotonga. I estimate the number in Tahiti to be about the same. These have been placed among the paleotropic species, the distinction between the two groups not being definite in many cases.

DERIVATION OF THE TAHITIAN FLORA

It is with a feeling of great presumption that I label the following paragraphs with the title just written. In the first place, the materials accumulated are neither adequate nor sufficiently studied to give an answer to one of the most difficult problems in the consideration of any flora and particularly of a Polynesian flora. I feel, however, that notwithstanding the condition noted above and my own imperfect knowledge of the data, some points make themselves sufficiently plain for suggestion. The percentages given, incomplete and lacking final form, nevertheless point strongly in the direction of a westward source for the bulk of the flora. The large proportion of species either identical with or closely allied to those now existing in the Indo-Malaysian region point to a stream of plant immigration directly or indirectly from Indo-Malaysia. What path did they follow, by what agencies were they propelled along their way, at what period or periods did they arrive, what sort of conditions did they find on their arrival, and to what qualities or factors did they owe their establishment and persistence? Similar questions arise in the case of other, but far smaller elements, the Pacific Element, the Subantarctic Element, the American Element, and the Boreal Element.

Skottsberg (1925) has rendered great service to those seeking definite criteria for discussing affinities of floras, from the point of view of possible origin by discussing data and views as to their value as evidence or suggestion in this direction. He seems to have pointed out certain lines of thought of the utmost value, both in general and in particular. I must necessarily refer constantly to his paper as to points raised in general and as to matters of particular application. After, or with, Skottsberg's paper, Guppy's consideration of plant distribution in Polynesia contains the most original and thought compelling data and views and must be constantly borne in mind (H. B. Guppy, 1906). Finally, out of numerous papers, those of Forest H. B. Brown contain striking suggestions which are later discussed in running commentary with Skottsberg's in the latter's paper of 1925. These three papers are mentioned because of their more constructive suggestions. The "land bridge" hypothesis plays a minor part or is opposed in all of these, but concrete application of both the dispersal and the geological factors are placed to the fore. The "land bridge" hypothesis figures largely in the paper by Douglas Houghton Campbell (1919). In view of the opinions expressed in these papers, the flora of the Society Islands, in connection with the other high islands of the eastern Pacific, affords some further data for discussion in connection with the general problem, occupying as these group islands do, the central eastern outposts of Polynesia (with the exception of Easter Island, still farther to the east). In accordance with foregoing statements as to elements of the flora of the Society Islands, I may briefly sum up the situation for these eastern archipelagoes as follows:

1. There is a definite representation of an old Pacific Element in these groups.
2. The overwhelming relationship, so far as identity of species or specific affinity is concerned, is with the Indo-Malayan region.
3. There is possibly an Australio-Polynesian Element, but it is not readily separable from the foregoing.
4. There is possibly a slight Neotropic Element in the indigenous floras.
5. There is a distinct Subantarctic Element, especially in the flora of Tahiti.
6. The Boreal Element is slight, possibly under thorough revision will be found to be wanting.

POSSIBLE HISTORY OF THE TAHITIAN AND RELATED FLORAS

Any consideration of the history of the flora of any Polynesian island or archipelago must necessarily be lacking in completeness or certainty. There are involved many conditions connected with the geological history, not only of the island groups themselves but of the continental masses and continental archipelagoes which surround the Pacific Ocean, as to whose origin only hypotheses of a general nature are available. There are under consideration such hypotheses as these:

1. The different groups of islands represent volcanic extrusions from the floor of the oceanic basin of the Pacific forming common bases for each group, out of which have been extruded, probably successively, the masses of the different islands of the group. The basal masses emerge from a depth of 15,000 to 18,000 or more feet and rise, usually in the form of a more or less curved ridge, to a general height of 9,000 or 10,000 feet. These ridges have a general direction of northwest to southeast, and the eruption forming the different islands may have proceeded in the same direction on each ridge or less usually in the opposite direction. The simpler high islands seem to possess a central dome of unstratified volcanic rock, whence layers of volcanic rock descend over its surfaces. Such structure is very evident in the main mass of Tahiti Nui, with an independent but adjacent mass forming the Taiarapu Peninsula for Tahiti Iti. Such an island as Tahiti Nui may have proceeded continuously to its ultimate cone-like form with little in the way of lateral vents of major proportions or even small parasitic vents of much later eruption. The Society Islands, single or double, seem to have followed this course, and present less complication than does Hawaii; where Mauna Kea, for example, was probably succeeded by Hualalai and by Kilauea, to be finally capped by Mauna Loa. If we accept the hypothesis of a continuous and regular volcanic activity leading to a comparatively symmetrical but somewhat elongated dome for Tahiti, a basis for succession is provided seemingly in conformity with the climax formations at present existing upon it. The original non-symmetrical cone becomes through erosion the dissected cone which so impressed James D. Dana (1849 and 1886) when he visited it with the United States Exploring Expedition of 1839.

2. The different groups of islands of the Pacific Ocean are parts of a larger land mass, a so-called Pacific Continent, or of larger mass groups in much closer connection than exist at present, but now

submerged so that only the higher peaks remain projecting. This hypothesis provides the land bridges, so necessary in the minds of their proponents for explaining the salient features of present distribution. Such an hypothesis finds favor with many biologists, who are its principal supporters. Geologists, for the most part, consider it biologically possible but geologically improbable. It seems that the chief arguments in favor of this hypothesis are based primarily upon the disbelief in the ability of dispersal agencies to distribute terrestrial organisms over extensive barriers, especially water. This argument has been carried to such an extreme that barriers of comparatively few miles are considered sufficient to prevent carriage or interchange (cf., for example, Fernald, 1911 and 1925). While land bridges are clearly to be presumed in certain cases, in their extensive interpolation, they must meet the objections of absence arguments, as opposed to those of presence, and these have been brought out in connection with the application of these ideas to the Pacific Ocean.

3. The Wegener hypothesis of continental displacement has been outlined by Skottsberg (1925, pp. 43-45) and discussed with relation to the Pacific islands. While it might assist somewhat in explaining the old Pacific Element, to bring the road from the Antarctic Continent more directly toward the Pacific Islands (if they existed at that time when the aforesaid continent was still a part of the Asiatic block), other questions naturally obtrude themselves which militate against such a relation. Skottsberg has made some suggestions in this direction. The theory does not account in detail for the origin of the Pacific islands.

There are therefore at least three main hypotheses as to the origin or earlier relations of the Pacific islands. It seems best, however, not to assume extensive but undemonstrable land connections or extreme emergence and subsidence of an extended type, but to assume a reasonable permanence of the continental platforms and oceanic basins, to limit emergence and subsidence to local areas or regions, and to seek possible explanation under such conditions as may be reasonably explained without too profound geomorphic changes. The difficulties of proof are large, since the water barriers range from a few hundreds to over 1000 and even to 2500 or 3000 miles in breadth, and actual dispersal over such distances is not readily and directly to be demonstrated. It is, however, even more difficult to demonstrate the possibility of sufficiently extended and practicable land bridges other than by the assumption that they alone can afford a reasonable explanation of the facts of distribution.

PATHS OF DISPERSAL

Three main paths of dispersal have been indicated, one from a general southerly direction, one from a westerly, and one from a south-westerly direction. There seems little indication, so far as the floras of eastern Polynesia are concerned, of the necessity of assuming eastern or northwestern paths, although it seems likely that, so far as dispersal possibilities are concerned, immigration from these directions is possible. From the southeast, there is slight but plausible indication of immigration. The great path of immigration from the west seems to be particularly indicated by the composition of the floras of eastern Polynesia, and this westerly stream, which also seems to be strong for Samoa and Tonga and even for Hawaii, is generally considered to be counter to the direction of transport of the distributing agencies since both winds and currents are easterly, seeming to favor transport from eastern to western Polynesia rather than in the opposite direction. To this matter I shall return later on. As to dispersal from the southwest, to bring the Australio-Polynesian element to eastern Polynesia and even to Hawaii, such an immigration stream might possibly join the general westerly stream and become merged. The southerly and southeasterly streams may have advanced along the westerly side of the Americas (evidences in Fuegia, southern Chile, Juan Fernandez, even in California) and then passed easterly across the Pacific under present conditions. If, however, we pin our faith to the Antarctic Continent as the center from which this stream of immigration went forth, we may assume a land bridge from this to South America since there is more geological indication of such a land connection than one from America to Hawaii or to Tahiti. The species migrating to South America and continuing to some extent along the coast may then have been in a position to continue their migrations westward even to Hawaii. There were, however, very different conditions in the south polar regions to make the Antarctic continental flora possible and what differences this may have made in the direction of dispersal agencies remains to be determined, especially if the components of the Andean chain had not been elevated to their present height. These considerations as to differing conditions in different dispersal periods will be touched upon under the next heading.

DISPERSAL PERIODS

That waves of plant migration have extended over the Pacific Ocean and at different periods, eras, ages, etc., of geologic time has been considered by Guppy, Brown, Skottsberg, and others. Guppy (1906, p. 220 *et seq.*) expresses his views as to the age of ferns and two eras of flowering plants, first those of endemic genera and second those of non-endemic genera. Brown (1921, p. 134 *et seq.*) has advocated the idea of three waves of dispersal, the first early in the history of Angiospermic development, earlier than the Lower Eocene of America, the second about the time of the Lower Eocene of America, both of these from the Americas, and a third wave with the advent of man. Skottsberg makes no especial point of eras or ages, but evidently regards two streams of migration as important, one for his Old Pacific Element from the Tertiary flora of the Antarctic Continent to South America on to Juan Fernandez and even to Hawaii, which was probably earlier than the Indo-Malayan or the Australio-Polynesian streams. The hypothesis of Guppy is extremely elaborate and assumes a dispersal wave in Mesozoic times (to account for the derivation of the Gymnosperms, especially *Dammara* of Fiji), while the dissemination into Polynesia is assumed to be later and as having taken place in Tertiary and recent time. It almost seems as if Guppy has created a hypothetical continent, submerged it at least largely, then caused emergence of islands, and finally extended his geological areas into Mesozoic time to account for the existence of one genus in the Fijian flora (cf. Guppy, 1906, p. 306). It must be said, however, that certain geological features of the Fiji Islands lend color to the suggestion of such drastic treatment although proof is not, as yet, complete.

While it is tempting to speculate in this connection on the ages of the different groups of Pacific islands, this is not the place nor am I qualified with adequate geological knowledge and insight to attempt to do so. The general idea seems to be that the volcanic rocks composing the high islands are Tertiary, but beyond that little opinion is expressed. That the present form, or an approximation to it, varies in age among the islands of each group, so that one island is relatively older, in this respect, than another, is held by one and another geological writer. I have ventured earlier in these notes to express such an opinion as to Tahiti being one of the younger of the Society group, so far as present form is concerned, and probably somewhat younger

than the present Island of Rarotonga. I have been led to these opinions as to Tahiti and Rarotonga through the absence of pronounced sunken valleys on both islands and the completely encircling barrier reef of Rarotonga, that of Tahiti still being incomplete. Neither island shows emergent coral reefs, but the forest climax has more completely covered Rarotonga (judging from Cheeseman's account) than it has Tahiti. Otherwise the two islands have striking floral features in common. The probable age of some high islands in the larger groups of the Pacific is seemingly sufficient to allow of having received the immigrant ancestors of the Old Pacific Element from the Tertiary Flora of the Antarctic Continent, the Society group included.

AGENCIES OF DISPERSAL

Nearly all writers agree that water carriage can account for much of the strictly littoral flora, although some of them have pointed out that the current direction is contrary to what has seemed to be the migration stream. *Barringtonia asiatica* has reached eastern Polynesia but not Hawaii, or at least has not become established there, and the same is true of certain other littoral species. The Indo-Malayan mangroves are not found in eastern Polynesia or in Hawaii although they are established in Samoa and Tonga. Guppy (1906, chap. 30) has discussed their distribution in detail. The absence of mangroves from Tahiti and Hawaii has caused much discussion. Guppy (*loc. cit.*) does not think that the "viviparous" fruits could endure a long journey, although they are unharmed after floating in sea water for three months or more. There are few places, however, along the coast of Tahiti where mangroves could thrive, since they do not seem to thrive on sandy beaches. In Hawaii, the American mangrove was introduced on Molokai and thrived. Its floating fruits are abundant on the windward shore of Oahu and a few became established there but did not persist (letter of C. S. Judd, Superintendent of Forestry of Hawaii, dated Nov. 10, 1925). Denial of carriage power to a dispersal agency based on absence seems extremely unsafe, since ecesis and persistent factors play such a large part in "presence" proof. A case in point is *Hibiscus tiliaceus* in Bermuda. The only cases of the presence of this species in Bermuda known to Britton (*Flora of Bermuda*, p. 239) were planted by man, and he notes that at least one is recorded which had been raised from a floating seed. A notable case in this connection is the absence of *Entada scandens* (used in the

broad sense) in the Azore Islands although the seeds are often cast ashore. According to Hooker (1864, p. 27), such seeds taken to Kew germinated and produced plants. This species has not yet been recorded from eastern Polynesia, although it occurs in Samoa and Tonga, 1300 miles farther west. May we not suppose an ecesic factor at work here rather than a failure of the dispersal agency? Were it merely a matter of dispersal to insure presence, we might expect *Entada scandens* on every coast and even inland, since Sernander (*vide* Guppy, 1906, p. 180) procured germination of seeds of this species and of those of *Mucuna urens* washed up on the beaches of northern Norway. If the seeds of these vines were inconspicuous it might most plausibly be argued from "absence" that its dispersal area was even much more limited than its distributional area and that land bridges might necessarily be assumed to account for the discontinuity in the latter.

It may not be possible to follow Guppy in all his ideas of the relation of water-borne littoral species to inland species (Guppy, 1906, chap. 15), but it seems to me that the present general charge that the possibilities of transoceanic migration are greatly overestimated or, as some believe, impossible, is due to placing greater emphasis on "presence" as proof of dispersal and less on the ecesic and persistence factors. Skottsberg (1925, pp. 27-30) gives a lucid discussion of this matter under the caption of "overestimation of transoceanic migration," in which he seems to rely largely on the "presence" and "absence" evidence, even as related to migrations between the different islands of the Juan Fernandez group or between those of the Hawaiian group, although under a previous caption (*loc. cit.*, pp. 20-23) he clearly indicates the importance of the various elements of migration, ecesis, establishment, and persistence. He seems fairly willing to admit the potentialities of transoceanic current dispersal but feels that wind-carried seeds and bird-carried fruits are still more rarely capable of crossing oceans. The cases seem similar to me but the evidence less readily observed. As in the case of water-borne germs, aerial distribution is contrariwise to prevailing winds. This has long been recognized and the agency in consequence, denied. There seems to be an explanation, however, in cyclonic winds and storms, not rare but frequent, with an ascending gradient of good carrying power, not only for seeds and fruits of fair size, but for carrying birds as well. Above 10,000 feet, reverse currents to those below are encountered, and of greater velocity than the regular trades,

westerlies, or prevailing winds, so that seeds, leaves, twigs, fruits, birds, insects, etc., are carried over greater distances and in much shorter time. While the idea is not entirely new (cf. Guppy, p. 585), and various reports on transmission of dust, pebbles, etc., tend to support it, it has been put into form recently by Vischer (1925*a*, 1925*b*, etc.).

A dispersal agency, however, is not to be thought of as uniform. Certain seeds, etc., may be delivered at one destination, certain others somewhere else, etc. As has been stated (cf. Salisbury, 1919, p. 54), it would involve but little exaggeration to say that every square mile of the earth's surface may have received dust from every other square mile, and also (Salisbury, 1919, p. 61), "it has been estimated that in violent dust storms the amount of dust and sand in the air may amount to as much as 126,000 tons per cubic mile of air." The loess formations indicate the carrying capacity of air for short distances perhaps not to be compared with transoceanic migration, but violently upward currents, especially such as occur in cyclonic storms (no longer to be considered rare), may carry such particles of dust, sand, vegetable débris, spores, and even smaller seeds above the 10,000-foot level to the influence of the extremely more rapid upper planetary winds favorable to carriage of even larger seeds than we are inclined to suspect (cf. Small, 1919, pp. 154-184, for further details of carrying efficiency of air currents). The eruption of Krakatau in August, 1883, particularly demonstrated the direction, efficiency, and other relations of these upper air currents. (Salisbury, 1919, pp. 50, 21, has epitomized the worldwide dispersal of dust and possibly of larger objects, resulting from this eruption.) Birds caught in cyclonic storms and the more local but possibly far dispersing tornadoes, may be carried up and well out of their habitat. Birds, under such abnormal conditions, buffeted and stressed, are likely to be unable to carry on their normal functions either of digestion or preening their plumage free from adherent particles, and would probably arrive at their destination with crops still full and mud or adhesive seeds or fruits still attached to their feathers. Such cases of bird-carriage agencies rely on the possibility of happening as well as upon numerous cases of known occurrence of birds out of proper range. They may be considered as of sufficiently frequent happening (cf. Furbush, 1925, pp. xix-xxiii).

I have evidenced the rather familiar examples noted in the preceding paragraph to indicate that even transoceanic and possibly even

circumterrestrial dispersal is probable, not only by water, where we have some tangible evidence to support it, but also by wind and bird (or bat) agency, where the immediate demonstration is not so practicable. The conspicuous eastward course of extension of distribution of Indo-Malayan plants seems attributable to the westerly currents of the upper air, carrying the smaller, lighter seeds at least, and reasonably frequently, through birds (for birds carried far out of natural habitat of course, consult Cooke, 1925, pp. xix-xxii) such as fruit-pigeons and especially cuckoos, or even fruit-eating bats, farther and farther eastward, to populate such islands as had not as yet completed their biotic quota and arrived at the condition of closed formations. It is of course to be realized that while, under dispersal, almost any species might be expected anywhere, yet analysis of the factor (D) will show it to be complex and show also the probability of some species being easily and extensively disseminated and of others being seldom if ever carried more than short distances. The factor D varies according to the comparative efficiency of buoyancy of other dispersal device (*d*) possessed by the organism, the effectiveness of the wind, water, or animal agency (*a*) concerned, and the time (*t*) over which dispersal opportunity may be operative. An important element in the working of factor D is the nature of the source of supply seeds as to whether readily deliverable to the agency of dispersal or not (cf. Vischer, 1925*b*). For example, seeds, etc., from scattered desert vegetation may be readily gathered by the wind, those of marsh and pool by water birds, those of fleshy fruits by frugivorous animals, while heavier seeds and hard fruits of dense forest may have fewer opportunities. This variable quality may be designated as (S).

In connection with the more or less selective action of the dispersal factors on the content of the land flora of Tahiti, little may be said in detail, but the absence of heavy seeded fruits, such as nutmegs as one of the most striking examples, whose eastward extension stops at Samoa, may be attributed in part perhaps to the low time variable in connection with the low device (*d*) and agency (*a*) variables. To express it briefly, as Guppy (1906, p. 409) has already stated, "Tahiti possesses very few that present any difficulty from the standpoint of dispersal." In the case of eastern Polynesia and its Indo-Malayan (or even Neotropic) element, the conditions are such as might be expected from dispersal over broad stretches of ocean and considering all elements of the factor D in full harmony with the (*d*) and (*t*) variables. The absence of heavy seeded (or fruited) plants seems to

indicate absence, rather than presence of land bridges, at least if viewed from the point of view of the D factor alone. The same argument probably also applies to Hawaii, which according to Guppy (1906, p. 409) possesses very few genera (less than 30) which are not found either in Fiji or Tahiti or both. Without verification and assuming the essential correctness of Guppy's estimate, it may be noted that this amounts to approximately the number of the endemic genera of Hawaii. These, excluding the arboreous Compositae and the Lobelioids, have their affinities largely in the Paletropics. A small group of arboreous or shrubby Malvaceae (such as endemic species of *Hibiscadelphus*, *Kokia*, and *Hibiscus*) seem to be eastern Asiatic in affinities and may possibly be attributed to wind or bird dispersal of their ancestors through influence of upward gradient due to monsoons.

The influence of factor D in the case of the Old Pacific Element and the Magellanic subantarctic element, in short of those elements possibly derived from the Tertiary flora of the Antarctic Continent, the course suggested by Skottsberg (1925, p. 45) and the possibility, or even extreme probability of land connections between Fuegia and Graham Land (cf. Wordie, 1921, and Ferguson, 1921) seem likely to be positive. Even without this land connection, if we are inclined to assume that the Tertiary flora of the Antarctic Continent furnished the ancestors of many (or all?) of the arboreous Lobelioid and Composite types of the world, the occurrence of such types along most of the present main routes of bird migration back and forth from the Northern Hemisphere to similar latitudes of the Southern Hemisphere, even possibly to the Antarctic Continent before the Glacial Period, is striking. Shore birds, for example (Cooke, 1910) from various parts of North America (cf. Cooke, *loc. cit.*, p. 9) pass in their annual migrations to southern Chile, Straits of Magellan, Falkland Islands, and Fuegia. Similarly, North American birds migrate from Greenland to Europe and on to South Africa. Under conditions of the Tertiary Antarctic Continent, it seems probable that such migratory streams of birds may have extended to the extreme southern latitudes and have been active agencies in the northward dispersal of certain of the species of the Tertiary Antarctic flora. The presence of moist, cool (neither too warm nor too cold) situations along the Andes, on Ruwenzori, etc., in Central Africa, and on the high islands of eastern and northeastern Polynesia may have not only attracted the migrating birds but afforded congenial homes for some species of the plants the

birds are extremely likely to have brought with them. Skottsberg (1925, p. 23) says: "Unfortunately the real long distance flyers are marine birds with a marine diet and do not come into contact with the inland vegetation, except under unusual conditions. Cyclonic carriage of water and shore birds, not strictly marine, is unusual though frequent." Moseley (1885, p. 783) has called attention to petrels' and puffins' burrowing into the moist soil at Tahiti, about the *Fitchia* association, and having their feathers smeared with soil and what it contained, and Guppy (1906, p. 24) also calls attention to the Tropic Bird. These are all sea birds, but I have been assured by Mr. Rollo Beck, whose acquaintance with the birds of central and eastern Polynesia is extensive, that the cuckoo is a far-flying bird and a fruit-eater. Cooke (1910, pp. 10-14) has called attention to shore-bird migration. Birds carry Australian seed as far as Formosa (rice paddy weeds as particular evidence—E. D. Merrill in statement to author), and Furbush (1925, pp. xix-xxiii) has given examples of storm-driven birds. As to why the migrating flocks of birds over the third possible route, viz., from Antarctica up over Australia, Malaysia, and eastern Asia, have not established more of the "Old Pacific Element" along this course than is readily demonstrable is, of course, a legitimate question and one without a ready answer except that here the uncertainty of what is due to dispersal and what to other factors may well be held to function. Indications of such a path of earlier bird dispersal are, however, not entirely lacking.

Much more might be said on the subject of agencies connected with paths of migration but sufficient has been suggested to indicate the strong presumption in favor of the D factor as effective even for trans-oceanic carriage. Details of discussion by Guppy in his various chapters cover fairly well this side of the discussion.

SUCCESSION IN RELATION TO INSULAR FLORAS

Very little attention has been paid to succession in oceanic islands. It is generally assumed that the microphyte flora appeared first, then the herbaceous flora (particularly the pteridophyte associations), then undershrub, shrub, etc., leading up to the forest climax; in other words, that succession has proceeded in the orderly and usual fashion of the seres, from the earlier stages to the climax, and of a series of seres each developing into or at least succeeded by another, xeroseres

succeeded by hydroseres, as the bare rock, or denuded surface, is progressively subject to disintegration, erosion, and deposition. The variation in water content of the substratum brings such a series to a climax, so far as the existing formation is concerned. It is far from my purpose to attempt to treat the land vegetation of Tahiti in respect to variety and history of succession. Observations and data are too scanty to serve any such purpose. The point of view of succession, however, may be brought to bear in following up the idea of paths of immigration and the agencies involved, as well as in discussing the possible derivation of the elements of its land flora.

Clements (1916) has exhaustively treated the general subject and has laid stress upon what he calls (1) initial causes, (2) ecesic causes, (3) reactions, (4) stabilization, and (5) climax. The primary factor is available water. The slopes of a volcanic island, such as Tahiti, judging from the more recent lava flows on the island of Hawaii, were, at first, either bare, fairly smooth rock ("pahoehoe") or rough, broken, porous, somewhat disintegrated blocks ("aa"). In both cases ("litharch") available water is scanty and vegetation is slow in making its appearance, generally coming first on the *pahoehoe* type but later also on the *aa* type, crevices becoming filled with pulverized fragments and a shallow soil resulting. The first appreciable growth is pteridophytic as C. N. Forbes (1921, p. 127) has indicated and my own observations, especially those made on the Island of Hawaii during the summer of 1924, have confirmed, *Gleichenia* (*Dicranopteris linearis*) associations being included. *Metrosideros* starts epiphytically on the pteridophytes and an open shrub formation follows. It seems likely from the slope formations found on the slopes of Tahiti (described earlier in these notes) that the primitive vegetation of that island was initiated as *litharch*, on *pahoehoe* or *aa* surfaces, or both, and proceeded to a closed undershrub formation of *Gleichenia* mixed with scattered shrubs of *Metrosideros* and *Dodonaea*. Such a formation of the slopes proper is found at present extending from a little above the coastal plain to about 5000 feet elevation, where it gradually gives place to the *Lycopodium* association, which extends 1000 or more feet higher. These are strictly xerophyte formations and are more definite on the slopes of the drier sectors, but occur also on the slopes (using the word in a definite and restricted sense) of even the moist sectors. That the xerosere still remains with an undershrub (or almost herbaceous) type of climax may be taken as an indication of the retention of primitive form by the slopes and as some proof of the youth

of the vegetation of the island. Invasion of these *Gleichenia* and *Lycopodium* associations seems possibly difficult but, as I have stated earlier, *Stenolobium stans* seems to have accomplished it and future years may show a change to high shrub or low tree formation. The mesophyte formations on Tahiti, outside of the coastal plain, are in moist depressions which I have called the uppermost swales or those at the valley heads, and the sides and bottoms of the valleys. Both sorts of habitat are due to erosion and disintegration. The succession here is not easy to trace, but probably has proceeded through microphyte, moss, herb (particularly fern), to shrub and tree. The formations are closed, the upper showing more largely the Old Pacific Element and the endemic element of Indo-Malaysian affinities, the lower largely showing Indo-Malayan species, especially as it nears the coastal plain in the moist sectors.

A consideration of the various stages of succession ought to accompany any attempt to discuss the derivation of any flora, but especially does this seem important in the case of an oceanic island. Ecesis, establishment, and advance to climax of any association or formation within the sere would if reasonably understood supply many reasons why mere absence ought not to militate against attributing a high degree of efficiency to the agencies even of transoceanic dispersal, and would lessen the temptation to assume far-reaching and complicated geological change. Skottsberg (1925, p. 21) has catalogued in clear and convincing manner the vicissitudes of migration, ecesis, and establishment, but these are little less present for land migration than for transoceanic if we except chances of carriage. "It may safely be said that, as a rule, even species eminently fitted for ocean dispersal extend their areas at a very slow rate," says Skottsberg, and again (1925, p. 30), "Even overland dispersal is generally slow." A study of succession and its stages, however, indicates that fresh areas lend themselves to the immigration and establishment of species often new to such neighborhoods, as slides, burns, freshly plowed or otherwise cultivated areas, etc., while closed associations, though they may yield to invasion through some accidental change, generally remain impervious to migrating germules. There are to be noted, however, certain cases in which closed associations of certain type are necessary. *Dipterocarpaceae*, according to E. D. Merrill (1923, p. 6) can develop only in a climax forest formation of advanced tropical type. Nutmegs seem to demand similar conditions. *Stenolobium stans* seems to stand forth on Tahiti as such an invader of the closed under-

shrub slope formations. Even such invasion of closed associations is probably possible only under more frequent bombardment.

From the view of succession, some mysteries seem less, or seem to be succeeded by mysteries of another type. At least, they may be as potent or more so, in explaining absence, as the denial of possible migration. The processes of ecesis and establishment depend in each case upon favorable interrelation of climatic (C), edaphic (E), and biotic (B) factors, and the closed formation may well indicate the cessation of effective invasion which Guppy (1906, p. 504) has designated as "the suspension of the agencies of dispersal in the tropical Pacific." This is the same condition that limits, to a certain extent, at least, the extension of certain plant associations on continents; but let this closed formation be broken and all sorts of invasions may take place to proceed to their proper climax formations under the climatic, edaphic, and biotic conditions which exist or arise. This applies as thoroughly to animal invasion (particularly bird) of well settled areas as to plant, but the balance may be upset by human interference, as the introduction of cultivated plants and weeds, or of animals, into what is for them a "denuded" area of opportunity for establishment.

After the germules arrive, in viable condition, the struggle begins. The climatic conditions, temperature and moisture, may or may not be favorable, and the edaphic conditions may be similarly influential; but the biotic conditions may be the most crucial and these are undoubtedly the conditions preventing entrance into closed formations. Praeger (1923, pp. 115, 116) has drawn a very vivid picture of biotic struggle even over a sparsely populated area and has emphasized the idea of the difficulty of obtaining a foothold on the part of a migrating germule.

The climatic factor (C), with its temperature moisture variable ($T \times M$) is clearly antagonistic to the majority of germules arriving on oceanic islands. It may be invoked with certainty to explain why germules arriving in Tahiti from such regions as the central or northern Andean region of South America, or arriving from the northwest coast of North America on any of the Hawaiian islands fail to become established or even find favorable conditions for ecesis, although the possibility of such arrivals seems more probable than those from other regions on account of favorable currents of wind and water, and even of bird and insect migration (cf. Cooke, 1910, p. 11; Felt, 1925, pp. 365-368). Even if ecesic conditions were favorable, the C factor would greatly assist, or militate against, an

adventive species in both competition and reaction, where optimum conditions are necessary to the invading organism. Most organisms are more stenothermal and more stenohygrophilous than may seem to be the case on incomplete observation and experiment. The argument advanced against dispersal possibilities purely on the basis of absence has become so extreme that germules, even small ones, are not deemed likely to cross even narrow barriers, particularly water. Fernald represents those who have taken this standpoint (cf. Fernald, 1911, pp. 141-162, and 1925, pp. 289-342). Fernald's accounts, however, are largely lacking in ecologic data pertinent to the query as to what climatic, edaphic, and biotic conditions are responsible for the continued existence of these floras where we now find them and as to what opportunity invading germules might have of surviving in such closed associations even if they arrived in such quantities as to present a constant bombardment. As Skottsberg has said (1925, p. 30): "It is of course necessary to direct attention to notable cases of absence of species, especially if they concern many islands in different parts of the world," and again (*loc. cit.*, p. 26), speaking of his field studies in Juan Fernandez, he states that he had the "strongest impression that the native vegetation in both places is to a considerable extent decidedly stenoclimatic." There is difference only in detail of barrier between such problems as those which Fernald has so exhaustively analyzed and the less satisfactorily treated oceanic islands. Fernald's unglaciated areas are islands, undoubtedly of distinct climatic, edaphic, and biotic complexes and separated from one another by wide barriers, and where the C.E.B. factor-complexes are sufficiently different to inhibit a biotic element other than of the same type as occurs on these unglaciated areas. He has also marshaled a suggestive series of facts, particularly as to the transport of seeds, etc., by birds and other animals to support the evidence of absence as an argument against dispersal possibilities. Fernald has (in his paper of 1911) brought forward many pertinent and thought-compelling facts that make one hesitate, as seriously as they do Fernald, in allowing any dispersal whatever. On the C.E.B. complex side, however, he has expressed himself only so far as the following: "Although from the insular position of Newfoundland we should naturally expect that her flora would lack many species, it is certainly by more than a mere coincidence that the island lacks a large proportion of the most typical plants which on the mainland to the west abound in similar latitudes and under *essentially identical conditions of climate and*

soil," etc. (*italics mine*). In his 1918 paper (p. 247), Fernald has, however, laid stress on certain edaphic conditions (acid soils and calcareous soils) and has seemingly admitted a time element to account for a recently adventive element, thus allowing somewhat greater operation of the dispersal factor. By insular position I assume, from the context, that comparative isolation is meant. "Essentially identical conditions of climate and soil," however, are not farther elucidated and give little assistance as to the "stenoclimatic" conditions demanded by most plant associations. The geological history in such cases as the two Fernald has treated so exhaustively and so satisfactorily from the floristic point of view, may have been strictly in accordance with his hypothesis, but his extreme outlawry of the D factor loses much of its force until fortified by further proof along the line of the C.E.B. factor complex. It seems clear that these associations in Newfoundland and on the unglaciated areas persist because their members are living under a favorable C.E.B. complex and should they be denuded might proceed by the proper sequence of succession again to the same or very similar climax through the operation of the D factor, although they may hold their own and have held it from glacial times, partly because of being a closed association. In either case it seems open to very considerable doubt to propose such extreme cloture against the D factor. These examples taken from Fernald are cited only to indicate the importance of discounting first the absence argument and to a certain extent also the alleged inefficiency of the factor of dispersal, as well as to call attention to the fact that while insisting upon the most absolute proof of the operation of the D factor, admitting or suggesting, as alternative paths of migration, much less readily demonstrable although possibly plausible geomorphic changes, a preference seemingly of the more complex over the more simple process of path and agency of migration.

The influence of the edaphic factor is recognized for the extreme conditions of substratum as being a limiting factor in distribution and consequently in ecesis and persistence (P). A certain quality of the available water of the soils, the salts, acid-reaction, etc., of the water, certain matters of texture, etc., are definitely demanded by one group of plants and a different quality of these by another. Its importance as a factor and its variables are admitted and comparatively well known. It is a prominent factor in the topographic distribution of the land vegetation of Tahiti and the lack of a suitable edaphic complex is probably partly responsible for the lack of man-

grove associations on the shores of the islands of eastern Polynesia, and together with the C factors, causes discontinuity in their distribution along the west coast of South America (see Guppy, 1906, pp. 483-501).

Finally, the biotic factor (B) should be discussed briefly, since it is a factor assuming greater and greater importance with each discovery as to the details of its influence. If eciesic conditions are favorable, there come to the invader the relations called by Clements "competition" and "interaction," and competition is distinctively biotic. In the plant's relations to other organisms through the successional stages to persistence, certain of these are essential to its individual establishment and certain to its establishment as a member of a plant association, while certain others militate against its existence in either of these relationships. Parasitic plants must meet hosts, mycotrophic plants must meet the proper fungi, and plants dependent upon or largely benefited by symbiotic bacteria must either find them in the soil or carry them with them. A very much larger number of species than we are aware of have some symbiotic relationship which is either necessary or extremely helpful in competition. (MacGregor Skene in *The Biology of Flowering Plants*, 1924, has summarized recent investigations along this line and given some bibliography.) Among Tahitian plants of such possible relationships, we may think particularly of the Myrsinaceae, the Rubiaceae, the Gesneriaceae, the Orchidaceae, and the Leguminosae. Certain tropical Rubiaceae not only depend to a greater or less extent on their symbiotic bacteria but carry them with them in the seed (between embryo and endosperm). Something similar occurs in some Myrsinaceae. From the presence of similar tubercular growths on the leaves of certain species of *Cyrtandra*, I suspect a relation of this sort in the Gesneriaceae. The relation of the germination of the seeds of Orchidaceae to fungus hypae with the possibility of dependence upon certain specificity as to the particular fungus for the particular species or small group of species of orchids is another pertinent case in point. Such relation adds to the complexity of explaining the absence, in large part, of Orchidaceae in Hawaii and the fair but not over-abundant representation of this family in Tahiti. Leguminosae are rare in the strictly indigenous flora of Hawaii and the root relation to symbiotic bacteria may have fully as much to do with absence on Tahiti and scarcity on other oceanic islands as with failure of migration. Consideration of such nutritional symbiotic relations, although as yet little known, is

important for presence and possibly significant for absence—e.g., absence of Cycadaceae and Podocarpaceae, whose symbiotic relations with microörganisms seem complex (cf. summary by Skene, 1924, p. 26). Another symbiotic relationship is that between plants and animals (birds and insects) necessary for pollination. Species of *Ficus* may be cited, in particular, as examples from insular floras. Species of this genus are wanting in Hawaii although present in other high islands of the Pacific Ocean. The relation between the nectar-feeding Drepanids of Hawaii and the peculiar Lobelioids of those islands is also to be thought of. The Drepanids are possibly even more peculiar among birds than the arboreous Lobeliads are among flowering plants and are often brought forward in various arguments connected with Polynesian problems of geographical distribution. I am indebted to Professor Joseph Grinnell for calling my attention to the fact that Reichenow (1914) places the subfamily Drepanidinae (comprising about 40 species and limited to the Hawaiian Islands) under the family of the Dicaeidae, or "Flowerpeckers," restricted to the Old World and represented by very many species ranging from Australia to India. This removes the earlier argument founded on the idea that they were related to the American Coerebidae.

In biotic relations there are, of course, many which are detrimental to establishment, particularly as to insect or other animal enemies. The much discussed case of the coconut, seemingly so extremely well adapted for water dispersal, but which has been denied (with some reason) effectiveness, may largely be due to the destruction of the germinating coconut, a tasty morsel, by the crabs (especially other than the coconut crab) and rats which abound, even on uninhabited islands. The biotic factor seems likely to be the limiting factor here, but is also not always completely inhibitive.

ENDEMISM IN THE TAHITIAN FLORA

Skottsberg (1925) has touched upon this subject as connected with insular floras again and again in his paper dealing with Hawaii and Juan Fernandez, and most pertinently. I have little to add. This element in Tahiti is much less proportionally than in either of the two groups mentioned. Larger and smaller areas, both insular and continental (cf. Fernald, in papers already quoted, as well as others) show that endemism and even a high percentage of endemics are not

confined to oceanic islands (Skottsberg, 1925, p. 2). The mechanism of evolution has not yet been demonstrated and the question of the evolution of genera and larger groups is even yet only a subject for general hypothesis. Tahiti shows only a very few endemic genera and only a reasonably large percentage of endemic species. There is some reason for suspecting a mixture of newer "mutants" and of "relicts," but as has been made clear by others, little that is definite may be postulated. While Brown's (1922) method of assuming a certain number of ancestors to account for an insular flora is suggestive and while his assumption of certain limited waves of immigration is also attractive, it is almost as safe to assume a more or less continuous process of arrivals with establishment according to regular succession until closing of associations makes invasion more and more difficult. This is, however, somewhat modified by the hypothesis of the derivation of a certain element from the Tertiary flora of Antarctica.

CONTINENTAL NATURE OF THE FLORA OF TAHITI

Skottsberg argues in the case of Juan Fernandez for an earlier continental connection and in the case of Hawaii for a larger mass to include all the islands, although it is not clear to me on just what grounds unless on the inadequacy of the dispersal agency. Similarly, we may think of the different islands of the Society group as connected, but we should add Rarotonga and probably also the Marquesas group. If this is done, why not join the advocates of a mid-Pacific continent? It does not seem at all a violent suggestion to have a larger Society land mass; but Rarotonga, so similar in its flora, is too far away to join naturally such an aggregation and rises from an entirely different submarine plateau. It does not seem to me to be necessary to unite the islands of the Society group into one land mass in order to explain either the resemblances or the differences of the floras of its several islands.

SUMMARY AND CONCLUSIONS

In the foregoing notes I hope to have demonstrated or assumed with some considerable logical basis, the following:

1. The ecological distribution of the land flora of Tahiti is simple and indicates comparative youth.

2. Analysis of the land flora of Tahiti, so far as the vascular plants are concerned, indicates two main sources: southern latitudes possibly from Tertiary flora of the Antarctic Continent; and western, overwhelmingly Indo-Malayan.

3. It presents no greater difficulty to assume trans-oceanic dispersal than it does to assume necessary geological changes to account for migration of the ancestors of the present flora.

4. Absence of floristic elements is not necessarily due to lack of migration, but may more plausibly be presumed to be due to climatic, edaphic, or biotic inhibition of development.

5. Migration may seem to have ceased because the invaders found it increasingly difficult to enter associations now closed.

6. Two main paths of immigration may be assumed, one eastward across the Pacific, in the equatorial belt but diverging both northward and southward; another along one of a series of bird migration routes between northern lands and the Tertiary Antarctic Continent.

7. Wind and bird dispersal agencies, eastward across the Pacific, are facilitated by cyclonic storms.

8. There seems to be no reason, either from the point of view of geology or of floral characteristics, for assuming much more if any land connection between the different islands of the Society group or with those of the nearer groups of Polynesia, than those at present existing.

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II. MARINE VEGETATION

BY

WILLIAM ALBERT SETCHELL

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Although the islands of the Pacific Ocean have been frequently visited by exploring expeditions and although plants have been collected from them since Cook's first voyage (1769-1771), comparatively little attention has been paid to the marine vegetation. In spite of a considerable number of references to algae or to marine spermatophytes, our knowledge is still fragmentary. We approach, then, a very different situation as to discussion of the marine vegetation of Tahiti from that which presents itself for a discussion of the land vegetation.

THE MARINE FLORA OF TAHITI

So far as I am able to ascertain, of approximately 50 species usually referred to Tahiti, a careful consideration eliminates all except about 30, the others being cited from localities in the Tuamotu Archipelago or as floating in the ocean between Tahiti and New Zealand, etc. Certain species such as the large kelps, *Macrocystis angustifolia*, *Lessonia Suhrii*, and *L. nigrescens*, or the monster Fucaceous *Durvillea utilis*, as well as the Gigartinaceous *Iridaea micans*, all Chilean species, seem clearly due to errors of labeling when credited to the coast of Tahiti. Of the approximately 30 species probably correctly referred, we collected all except two and added somewhat over 100, of which 15 are described as new. Although careful search was made for marine spermatophytes (particularly species of *Halophila*), it was not successful and there is no record of the occurrence of any species in eastern Polynesia (Society, Tuamotu, Marquesas, Cook Islands). The marine vegetation, therefore, seems to be made up entirely of the marine algae.

STATISTICS OF THE FLORA

Our revised list of Tahitian marine algae amounts to only 149 species, a small number which is likely to be increased by one who has the opportunity of collecting in Tahiti during the warmer seasons. In all known cases of the marine algae of tropical islands of the Pacific, the number is small. Boergesen (1924, p. 247) describes or lists 68 species from Easter Island but the collections available were few. On Tutuila, one of the Samoan islands, I detected 90 marine species of algae, although in mass the marine vegetation was slight and, except for the calcareous forms, inconspicuous (cf. Setchell, 1924, pp. 152-184). Tilden (1901) lists 100 species of algae from the Hawaiian Islands, of which 32 are either non-marine or diatoms (not included in the other estimates), leaving 68 species from Hawaii. MacCaughey (1918) has brought together all the algae listed from the Hawaiian Islands (without critical revision) and among them we find many marine species. Although all these lists are incomplete, we may compare them with 227 marine species (cf. Howe) for Bermuda, also an oceanic island but within the influence of the rich marine flora

of the West Indian region. For the Bahama Islands, which are, however, continental, the number of marine species given is 315, and for the Virgin Islands (formerly the Danish West Indies) there are enumerated 327 species (cf. Boergesen, 1920). Collins (1901) has enumerated and discussed 224 species of marine algae from Jamaica, another of the West Indian islands. From such figures we may infer, although of course the data are incomplete, that the marine flora of an oceanic island is less complete than that of a continental island, just as the land flora is. The situation is largely, at least, what we might expect from haphazard dispersal, a matter to which we shall return later.

GEOGRAPHIC ELEMENTS OF THE FLORA

In order to indicate so far as may be possible with our imperfect knowledge of the marine algae, something of the geographical distribution of the species thus far found on Tahiti, I have segregated them into eight groups, as follows: (1) Endemic species; (2) Polynesian species; (3) Indo-Malayan species; (4) East African species; (5) Mediterranean species; (6) East Atlantic species; (7) West Atlantic species; and (8) East Pacific species, and give in the following table the number and percentage of the Tahitian species found in each geographic division.

DISTRIBUTION OF TAHITIAN MARINE ALGAE

	Per-centage	Total	Myx.	Chlor.	Mel.	Rhod.
Total Tahitian species . . .	100	149	20	47	25	57
(1) Endemic representation	17	25	3	5	7	10
(2) Polynesian representation . . .	83	124	17	42	18	47
(3) Indo-Malayan representation . .	50	75	9	22	12	32
(4) East African representation . .	28	42	4	13	9	16
(5) Mediterranean representation . .	11	17	5	4	3	5
(6) East Atlantic representation . .	14	21	7	7	4	3
(7) West Atlantic representation . .	30	4	8	16	8	12
(8) East Pacific representation . .	13	19	3	8	6	2

The endemic species number 25, or 17 per cent of the total. This percentage will undoubtedly be much reduced as soon as the algae of other Pacific and Indo-Pacific shores are more thoroughly worked over and more cases of identity established. These endemic species are distributed thus: 3 Myxophyceae, 5 Chlorophyceae, 7 Melanophyceae,

and 10 Rhodophyceae. Of the 25 endemic species, 19 are either proposed as new or raised from varietal to specific rank in my paper on the Marine Algae of Tahiti (Setchell, 1926).

The Polynesian or central Pacific species other than endemic, either tropical or of warm extra-tropical waters, number 124, or 83 per cent of the total. More of these will undoubtedly have their ranges extended into the Indian Ocean—at least into its eastern portion.

The species extending to the Indo-Malayan region number 75, or 50 per cent of the total. Nearly all these species, however, are known to extend only into the northeastern and central eastern portion of the Indian Ocean, and also most of them are not known to extend to the western shores of the American continents. On the other hand, our knowledge of the algae of the tropical portion of the eastern coast of Africa is very incomplete, and there seems to be good reason for expecting a considerably larger representation of this group of species on those shores as our knowledge increases. The center of distribution of the three groups of species so far outlined seems to be on the continental shores and those of the archipelagoes of the Indo-Malayan region, a knowledge of whose marine flora we owe largely to the exploration of the Siboga Expedition and the resulting monographs prepared by or under the direction of Dr. Anna Weber-van Bosse (cf. Weber-van Bosse, A. and E. S. Gepp, Reinhold, and Foslie). There seems to be an Indo-Malayan center of distribution for the marine flora as there is for the distribution of land flora with very similar relations as to migration outward as far as eastern Polynesia in one direction and to the Seychelles, Maldives, Laccadives, and to some extent to the East African coast in the reverse direction. These supposed derivatives in the Tahitian marine flora will be designated as the Indo-Malayan Element. If we consider the groups of species considered under endemic (1), Polynesian (2), and Indo-Malayan (3) as belonging largely if not entirely to this element, it possibly may comprise as much as 86 per cent of the total assemblage, as will be shown later on. From the climatic point of view, which will be considered later on, this is a truly tropical element, that is, characteristic of waters averaging little under 25° C as annual isotherm.

The fourth group is that common to Tahiti and the East African coast, comprising about 42 species, or 28 per cent of the whole number. With few exceptions these are also represented in the Indo-Malayan region. With the Indo-Malayan, they belong to the paleotropical element, which includes about 28 per cent of the total number of species.

The fifth group, that of species common to Tahiti and the Mediterranean and Adriatic seas, numbers only 17, or about 11 per cent of the total. While this group is small, its existence is possibly of decided significance. The Mediterranean region is largely subtropical, the more tropical portions being largely unsuitable for algal growth.

The sixth group comprises those species common to Tahiti and the east coast of the Atlantic Ocean, particularly those of the "Atlantic Islands." The coasts particularly concerned are more tropical than those of the Mediterranean and when these groups of islands are better explored, especially the Cape Verde group, there may be expected a great addition to our knowledge, which is now largely confined to the flora of the Canary Islands. This flora is showing more and more agreement with that of the West Indies (cf. Boergesen, 1925, pp. 7, 8). There are 21 Tahitian species, or 14 per cent of the total, which occur also on the east Atlantic coasts. Most of these, however, are also of general occurrence.

The seventh group of species is the group common to the Pacific and possibly also the Indian Ocean and the West Indian region of the Atlantic coast of the Americas. This is a fairly large group, less so in Tahiti than in Hawaii, as I hope to demonstrate elsewhere, amounting to 44 species or 30 per cent of the total marine flora. There is a possibility, as well as probability, that this percentage will be reduced when our critical knowledge of the Tahitian flora is increased. I propose to designate the essentials of this group (leaving out those of general distribution) as the West Atlantic Element and to discuss its relationships to the paleotropic element later on.

There is nothing in the marine algae distinctively "Old Pacific" in the same fashion as that element exists in the land flora. There are no endemic genera of isolated systematic position. My *Dictyota(?) hamifera* is peculiar and may possibly, when fruiting material comes to hand, be found to be isolated or most nearly related to the Australian genus *Lobospira*, though I do not feel justified in assuming such a position for it. It seems best to distinguish five elements in the marine flora of Tahiti: (1) the pantropic, (2) the Polynesian, (3) the paleotropic, (4) the neotropic, and (5) other possible elements, and to discuss briefly their derivation and possible paths of, as well as agencies in, migration. For purposes of discussion, I have arranged the content of species of these elements and their subdivisions in the following table:

Element	Per-centage	Total	Myx.	Chlor.	Melan.	Rhod.
Total Pantropic.....	11	16	3	3	6	4
Total Polynesian.....	47	70	12	24	9	25
Indo-Malayan.....		25	2	8	1	14
East African-Indo-Malayan.....		17	0	4	3	10
Total Paleotropic.....	28	42	2	12	4	24
Polynesio-West Indian.....		5	1	2	1	1
Polynesio-Indo-Malayo-West Indian.....		5	0	1	3	1
Old World-Polynesio-West Indian.....		9	0	6	1	2
Total Atlantic Neotropic.....	13	19	1	9	5	4
Total Tahitian species.....	100	149				

There remains the eighth group of species, those of the eastern Pacific, largely from the Gulf of California down to Peru, the strictly tropical shores of which are either barren or unknown as to their algal population. This region has 19 species in common with Tahiti, most of which, however, are also widespread.

1. *The Pantropic Element.*—The Pantropic Element of the Tahitian marine flora includes 3 Myxophyceae, 3 Chlorophyceae, 6 Melanophyceae, and 4 Rhodophyceae, 16 species in all, or 11 per cent of the total, found in the Atlantic, Pacific, and Indian oceans and on both the east and west shores. Assuming that the transport of the marine algae is largely, if not entirely, by water, this general distribution may point to a period in geologic time when these various oceans were in more open and direct connection than they are now. Since only comparatively shallow waters are necessary to permit the migration of marine algae, themselves confined to the photic zone, such connections are not difficult to find. In the Cretaceous Period, the oceans were practically one and, if we accept the successive relations of continental platforms and oceanic basins outlined by Wegener (1924) in his continental displacement theory, were absolutely one until late geologic periods. The connection between the Atlantic and Indian oceans through the Tethys seas in various geologic eras was more or less direct, and continued until early and middle Tertiary times (cf. Ostenfeld, 1918, pp. 14–17). Likewise there were connections across the region of Central America between the Atlantic

and Pacific oceans in the Tertiary, as Svedelius (1924, pp. 8-13) has brought forward in his able discussion of the relationships of tropical marine floras. The pantropic species in general may be assumed to be the older, although exception or exceptions may well be taken to such a wholesale assumption. Such genera as those of the unicellular Myxophyceae, or even of the most complex of that group, such as *Calothrix* or *Hydrocoleum*, some of whose species belong also to the fresh-water flora probably existed as early as pre-Cambrian times, as is evidenced by the concretionary deposits presumably built up by them (cf. Walcott, 1914). Species of the less differentiated genera of the Chlorophyceae, such as those of the Ulvaceae, and even the Rhodophyceae of elaborate growth form and presumably equally complex structure, existed in the middle Cambrian (cf. Walcott, 1919), while complicated calcareous forms of the Siphonales are very definitely known as early as the Carboniferous. Of the existence of the perishable plant bodies of the great majority of the algae which do not lay down lime or silica, there is little evidence in the geological record nor could we expect it, but the calcareous red algae of the Melobesieae, highly organized types, occur in marine limestones from the Cretaceous on into the Tertiary. So far as the geological record is concerned, we may assume that the marine algae arose early and reached a complexity as considerable as that existing at present, in geologic time so early that paths of migration into any ocean were open. Hauptfleisch (1897, pp. 545-569) has brought together a list of the described genera of fossil algae which shows something of the recent condition of our knowledge. There is, however, another aspect of the situation to be considered. While it is true that the majority of the genera of marine algae are represented in all oceans, yet there are a few with decided limitations, and some are more largely represented in certain regions than in others. This is possibly due to different temperature relations of the species, for all marine algae, as in fact all organisms, are in my opinion stenothermic, some, because of slower developmental processes and less continued tolerance of other temperatures, being more plainly so, while others, not thus limited, may endure unfavorable temperatures for longer or shorter periods, although they neither grow nor reproduce when subjected to them (cf. Setchell, 1920). As to when climatic differentiation began and as to the progress of such a process, little can be surmised but it seems possible that stenothermy has always been the rule, since it is fundamental. Differentiation has probably progressed along stenothermic

lines. Another differentiation may be assumed along lines of endurance of unfavorable temperatures, but well within the limits of those causing death. This has to do not only with seasonal phenomena but also with those shorter periods of discontinuity of temperature at which metabolic or reproductive activity may proceed, to which most plants (including algae) must be subjected. The greater the adaptivity to such conditions, the more likely the species is to be widespread. It is the capacity to meet and survive such unfavorable conditions for persistence that marks the wider distribution. The species of the pantropic element in Tahiti are largely those which may be found also in subtropical and even in temperate waters and, in such extra-tropical localities, are either seasonal or to be found only in warmer spots. There are a few of the "wides" or pantropic species as I have called them, that do not seem to possess such adaptation. These we may presume, are the oldest. Such, in Tahiti, are *Hydrocoleum lyngbyaceum*, *H. cantharidosmum*, *Halimeda Opuntia*, *Caulerpa Webbiana*, *Zonaria variegata*, *Jania adhaerens*, *J. corniculata* (*J. rubens?*), and *Fosliella farinosa*. Some of these may be eliminated on further study or others may be added to them, since there is little in the nature of these species other than their alleged general distribution to cause them to be singled out as older representatives even of their respective groups. There seems to be better reason for supposing them to be of more ready dispersal than of greater age in geologic time.

2. *The Polynesian Element*.—The total element of the Tahitian marine flora, restricted, so far as our present knowledge goes, to Polynesia, numbers 70 species (including endemics), or 47 per cent of the entire marine flora. As has previously been mentioned, there is nothing distinctive either as to the genera or larger groups of this element, to suggest that it was derived from another source than either the pantropic or the paleotropic element, being in this respect very different from the "Old Pacific Element" of the land flora.

3. *The Paleotropic Element*.—Under this element have been placed two geographical groups of the Tahitian marine algae: the group of species known to be common to Tahitian coasts and those of the Indo-Malayan region, and to both of these and the western Indian Ocean. The number of species assigned to the paleotropic element totals 42, or 28 per cent of the total number of species credited to Tahiti. Most species of this group found in Tahiti are closely allied to Indo-Malayan species and to separate the few that are not would not be safe. The

reasons for considering the center of distribution for this element to be in the Indo-Malayan region is that these species or their near relatives are more abundant in that region, which is also continental, at least in part. From the present distribution of marine algae, it appears that while the tropical species may have been widely distributed, or at least have had the opportunity to spread over all oceans, temperature, in connection with other relations such as edaphic (substratum) and biotic, probably early caused localization and establishment of certain centers whence migration has proceeded.

4. *The Atlantic Neotropic Element*.—About 19 species, or 13 per cent, of the Tahitian flora are found in Tahiti (or in Polynesia) and also in the West Indian region but not on the east Atlantic coasts. These species are simply a part of the marine flora of the Indo-Pacific region, which is found elsewhere only in the West Indian region. This West Indian or Atlantic neotropic element is of peculiar interest and probably of great significance in the matter of its derivation. Did this element migrate from the Pacific into the West Indian region or did the migration proceed outward from the West Indian region into the Pacific and onward to the Indian Ocean? If the decision trends toward the latter, the further question arises as to the probable source of the West Indian marine flora. A third suggestion may be made as to whether the West Indian flora may not be a remnant of the former widespread marine flora of the Cretaceous or even earlier period, the eastern Atlantic representation of which has been inhibited or possibly even extinguished, by the unfavorable nature of the coast (due to Sahara sand and Congo mud) as the southward extension of the West Indian marine flora along the tropical coast of Brazil may also have been prevented or blotted out through Amazonian influence. In other words, the striking and certainly luxuriant flora of the West Indian region appears to be a "pocket" flora, whose distinctive features are lacking in the tropical marine flora (itself almost wanting so far as we have any evidence) of the rest of the Atlantic Ocean. There is great expectation that more careful exploration, particularly of the subtropical and tropical islands off the northwest coast of Africa, will more nearly equalize and complete the data necessary for a satisfactory discussion of this problem. Boergesen (1925, pp. 14-17) has already indicated that there is a greater resemblance between the marine flora of the Canaries and that of the West Indies than has been supposed. When the truly tropical portions of the east Atlantic have been thoroughly explored, the true relations of the West Indian

isolated or "pocket" flora may become more evident. Tahiti does not show such evident relationship as Hawaii. At Honolulu I have myself found such seemingly distinctive West Indian marine species as *Cladophora fuliginosa*, infested with *Blodgettia Bornetii*, *Siphonocladus tropicus* (now also known from the Canaries according to both Vickers and Boergesen), and *Dictyopteris Plagiogramma* (long known from Hawaii and possibly from Australia). Such features of the West Indian marine flora as appear in the Mediterranean region or on the Atlantic Islands appear to be tropical species which can also endure seasonal subtropical conditions as well.

5. *Other possible elements.*—The element peculiar to Tahiti (or to Polynesia) and the Mediterranean region is slight and doubtful, consisting of one or two species whose identity is by no means certain. The same is true as to an element peculiar to Tahiti (or to Polynesia) and the eastern Pacific (coasts of America). Of the four or five species possibly to be considered as belonging here, we may either expect all in the Indo-Malayan region also or find exact identity doubtful.

DISCONTINUITY IN DISTRIBUTION OF THE MARINE FLORA

Svedelius (1924) has treated of this subject exhaustively and has brought forward the literature dealing with the subject. The case is, as it seems to me, even stronger than he presents it. Algal genera are largely widespread and each addition to our knowledge simply confirms this opinion. The more local genera are largely to be found outside truly tropical waters, being more particularly represented in the groups of Melanophyceae and Rhodophyceae. A general discussion of the boreal group as distinguished from the austral groups lies outside the scope of this paper, but the discontinuous distribution of the families Fucaceae, Dictyotaceae, and Laminariaceae as to genera may be taken as examples of such distribution in regions separated only by a broad oceanic (not continental) barrier and due largely to the factor of temperature. It is of interest also, although only of general bearing on the derivation of the marine flora of Tahiti or of the tropical oceanic islands of the Pacific Ocean, to notice that discontinuous distribution within the genus (e.g., *Laminaria*, *Macrocystis*, *Ecklonia*, etc.) occurs largely along the eastern shores of the Atlantic and Pacific oceans, where cold upwellings or cold currents possibly assist in bridging the barrier of warmer water. The line of thought

suggested by the papers of Svedelius (1924), Ostenfeld (1918), etc., might be pursued still farther, but it is chiefly as to species, which are uncertain data at present, that any of the Tahitian marine flora show sufficient affinity with any region outside the Indo-Malayan to raise any question as to late invasion from any other region.

AGENCIES AND PATHS OF DISPERSAL

From what has been said in the foregoing paragraphs, it may be surmised that discussion of such matters as agencies in dispersal and paths followed may well be brief. We know little of any dispersal agency for marine algae other than ocean current or drift, and little of that in any certain detail. With marine spermatophytes not only uprooted plants may float, as they do at times in great quantities, but also seeds may float or presumably be wind-carried, fish-carried, or water-carried. There are no marine spermatophytes recorded from the Society, Marquesas, or Cook Islands, although *Halophila* is known from Hawaii, Samoa, Tonga, Fiji, westward into the Indo-Malayan region and southward to tropical or even temperate Australia. If this absence from eastern Polynesia is finally made certain, it will demand explanation. The marine algae are to be suspected of being transported over long distances largely by current and by drift and largely in the form of plants torn from their attachments, although the spores of some species may possibly be transported in the same fashion. Dispersal through fish agency, although supported by the testimony of Piccone (1883, p. 45), cannot be relied upon in general or for long distances. Most marine algae, whether or not possessing pneumatocysts or similar structures, are sufficiently buoyant to be carried by moderate current or drift over long distances. The chief inhibiting condition here is death and decomposition, likely to be brought about particularly by temperature change of the water traversed and changed conditions of light, oxygen, salt content of the water, etc. Even massive calcareous algae may be carried by currents, torn away in fragments, as they often are, but still attached to buoyant algae growing on them or even penetrating into their substance (cf. Setchell, 1924, p. 255). Such an alga as *Caulerpa cupressoides* var. *mammillosa* of Rose Atoll might readily carry fragments of *Porolithon craspedium* with it, of sufficient size and spore content to initiate a growth of that species on some far distant coral reef.

As to paths of transfer, on the supposition that the Tertiary age of the Society Islands is taken as approximately correct, and supposing that current and drift in the Pacific Ocean were not essentially different from those of the present, the same general relations to the Indo-Malayan regions would hold as in the case of littoral spermatophytes. In such case, the chances of certain species being brought and effectively placed and of others not, would result in the similar condition obtaining as among spermatophytes of the littoral; some would be present while others seemingly as well adapted for transport and establishment would be lacking. There is the same general result in the case of the littoral marine flora as in the case of the littoral land flora.

There is possibly as much necessity for proposing land connections (or at least shallow water connections) in the case of the smaller and more delicate algae as in the case of less readily transported land plants. Currents seem adverse and plants and germules not readily transportable, while wind carriage seems largely, if not entirely, out of possibility. Vischer (1925) has made suggestions as to the possibility of current reversal under storm conditions.

TOPOGRAPHIC DISTRIBUTION OF THE MARINE FLORA

The coast of Tahiti is surrounded, except along its northeastern and southeastern sectors, by a well-developed barrier reef, broken only here and there by passes. Where there is no barrier reef on the sectors referred to, there is a barrier bank completing the circumvallation of the island and presenting the same general topographic features except that the banks do not rise to the surface, their uppermost portions being from twenty-two to thirty or more feet submerged. They may be regarded as on their way toward becoming barrier reefs when their growth shall have been completed. They have "passes" through them, a moat within them, and in every way seem a continuation of the circumvallation, as I have thought best to call it, of the island. There is a third but much shorter interruption of the encircling barrier reef by a barrier bank opposite Taravao Bay on the northeast side of the Taravao peninsula connecting the two masses of Tahiti Nui and Tahiti Iti or Taïarapu. The "Dolphin Bank" is a similar although more local structure to the southwest of Point Venus, or perhaps this may be considered as the extreme of the northeastern barrier bank. Within the barrier reef and barrier bank as well, there

is a steep-walled depression, the lagoon or lagoon moat, as it may be called, to distinguish it from the similar but differently shaped lagoon of an atoll. The lagoon moat varies much in width but is comparatively narrow and its depth varies from about fifty feet to well over two hundred feet, the extreme depths to be found opposite the barrier banks. At the passes, the depth is two hundred feet or deeper. Within the lagoon moat the coast is skirted with broad fringing reefs opposite the barrier reefs but is usually of naked basaltic rock or with small disconnected patches of fringing reefs (incipient) opposite the barrier banks. We may distinguish then the different shore regions into (1) barrier reefs, (2) exposed fringing reefs, (2) protected fringing reefs, (4) exposed basaltic shores, and (5) barrier banks. There are in addition small beaches, both of coral sand and mud, as well as of volcanic sand or a mixture of coral sand and volcanic sand.

ECOLOGIC CONDITIONS

The temperature of the waters about Tahiti has not been determined with accuracy over sufficiently long periods to allow of detailed statement. In the coolest portion of the year, the temperature of the lagoon moat falls to 25° C and may perhaps go somewhat below that, but I think very little lower. The upper limit is probably 28° C to 30° C, for the deeper water, but in the shallows undoubtedly it rises well above 30° C. We were able to observe something of a seasonal variation in the marine vegetation between the time of our arrival late in May and our departure in late July. Certain species such as *Chnoospora pacifica* and *Hydroclathrus clathratus*, forming considerable associations when we arrived, became scarce before our departure, and wholesale changes took place in the Sargassum associations. We missed the spring and summer conditions entirely and if there is any considerable marine flora peculiar to these seasons, it left no traces.

We made no investigation of the salinity of the water but saw no vegetational indication of any considerable variation, even near the mouths of the larger rivers, such as the Papenu, the Punaruu, and the Vaitepiha. We did not meet any distinctive brackish water flora. Decrease of salinity is supposed to cause the breaches through the barrier reefs known as "passes" and there may be truth in this explanation. The larger passes, however, seem to be due fully as much to the attrition of basaltic cobbles brought down in quantity by the larger streams and accumulating in masses that are dashed about by currents and wave action, as to influx of fresh water.

The broad surfaces of both barrier and unprotected fringing reefs are exposed nearly every day at periods of low tide to the air and to the direct rays of the sun. Nevertheless, the surfaces are frequently covered with associations of algae, of no considerable variety, but occurring in extensive belts of different algal species. Shallow waters were often destitute of either coral or algal associations, but frequently were filled with the one or the other association, the two being seldom found together.

FLORAL RELATIONS OF THE BARRIER REEFS

The only portions of the barrier reef actually visited by us were those opposite Papeete, on both sides of Papeete Pass, and a sort of combined barrier and fringing reef opposite Atiue in the District of Punaauia. The algal conditions were essentially the same in both localities. Other portions of the barrier reef were observed from high points of the shore by the aid of good binoculars, and the barrier along the east and north shores of Moorea was observed from a gasoline schooner which coasted along within short distance of it so that the glasses showed all essential detail.

At even moderately high water, the waves pass over the top of the barrier reef and it is constantly submerged in a surge while at low water it is laid bare. The formations of the top of the barrier reef are, therefore, cumatophyte (or surge-plant) formations. The broad, nearly level surface of the barrier reef exposed at low tide is formed of one lepyrodophytic (crustaceous) lithakophytic (stony), heliazophytic (sun-loving), cumatophyte, *Porolithon onkodes*, whose extended and confluent crusts, half an inch or more thick, form a pavement-like formation usually spoken of as the "Lithothamnium zone." From a distinct ridge line, parallel to the wave fronts, it slopes very gently and slightly toward the ocean on one side and the lagoon moat on the other. From the ridge I measured the *Porolithon onkodes* association down beneath the waves of the ocean to a distance of about 120 feet, all seemingly of the same formation and about six feet deep in water at its outer limit at low tide. From the ridge downward toward the lagoon moat the formation could be traced for about 100 feet, when it became broken and fragmentary, passing over into coral sand and living or dead corals covered with shallow water at time of low tide and sloping toward the edge of the lagoon moat, where there was a sudden vertical drop of 80 to 100 feet to the bottom of the lagoon moat.

The Porolithon association is smooth and firm but may be cracked with heavy blows from a sledge and pried off with chisels in the form of irregular slabs. The Porolithon association increases in thickness only slightly per year (about $\frac{1}{8}$ to $\frac{1}{3}$ mm.), and estimates may be made as to the length of time necessary to produce such broad formations as are to be found on the barrier reefs of the Society Islands. This matter will be taken up later.

Inland from the Lithothamnium ridge (10 or 12 feet at Papeete) and covering the older Porolithon pavement is usually to be found, at least in their proper season, a broad belt (50 to 60 feet across) parallel to the ridge and wave crests composed of two distinct, or at their junction more or less intermingled, dense Sargassoid associations, the outer of *Sargassum sociale*, the inner of *Turbinaria ornata*. These associations, except at their junction, are practically pure associations, living upon and extending over what may be the oldest portion of the Porolithon association. Within the Sargassoid belt, the Porolithon association, no longer fairly continuous but broken and mixed with rosulate *Acropora*, *Pocillopora*, and massive *Porites* corals, continues for a space (about 25 or 30 feet at Papeete) when it passes into the coral sand and mud formation, mixed with the scattered coral clumps already spoken of. Besides the three species of algae mentioned as occurring in belts on the barrier reef surface, the only noticeable species was *Chlorodesmis comosa*, a typical cumatophyte, occurring in scattered bright green silky tufts a few inches across, on the outer portion of the Porolithon belt, and, less frequently, well developed tufts of typical *Caulerpa Freycinetii*. Besides the Porolithon, there were observed only a few other crustaceous corallines (Melobesiaee) usually inconspicuous, their encrusting forms, pholadophyte skiarophytes (snuggling into dark hollows), but here occurred also the only fruticulose nullipore (Melobesiaee) found by us on Tahiti, viz., the widespread Indo-Pacific *Lithophyllum Kaiserii*. A calcified crustaceous red alga of the family Squamariaceae, *Cruoriella conchicola*, was also detected among our collections from the barrier reef off Papeete.

Beneath the Porolithon pavement was a fairly compact mass made up of a framework of corals firmly cemented together by nullipores but with interstices, larger or smaller, generally filled with coral sand or rubble. There did not exist on the barrier reef any such hollows or channels, opening above, through which the waves could cause spoutings or "sucking noises" such as are characteristic of the exposed

fringing reefs. Another structural feature in which the barrier reefs (always exposed to wave violence, of course) differed from the exposed fringing reef was that both inward and outward it sloped gently from a slightly pronounced ridge until well covered even at low water. Farther out the slope became more abrupt (cf. Challenger Reports, 1885, pp. 777-781, and Alexander Agassiz, 1903, pp. 150-152). The exposed fringing reef has an abrupt drop, usually even a pronounced overhang, on its outward edge, which shows a reef of entirely different inception and development from a barrier reef.

Off Atiue is a barrier reef joined to a fringing reef along the northern edge of Punaruu Pass, so that at low water one can walk or easily wade out to the barrier reef. This condition seems due, partly at least, to local disturbance indicated by a fault with vertical displacement of two or three feet, to be traced northward about a mile. This is the only indication of elevation of reef rock seen by us in our trips to the various reefs. The barrier proper off Atiue was raised along its inner edge about three feet above what appeared to be the outward extension of the fringing reef which ended against this low vertical face of the barrier. The floral relations of the barrier reef were the same as that at Papeete.

POVERTY OF THE LAGOON MOAT AS TO ALGAE

The lagoon moat was examined for several miles in the vicinity of Papeete by means of a glass-bottomed boat. The water was clear, the sides and bottom white, and it was possible to clearly distinguish objects at the bottom, 100 or more feet down. So far as we could see, there were no algae either on the sides or on the bottom, at least in the cooler season. The walls of the moat were largely built up of the coralla of a slender, cylindrical, branched species, possibly of *Porites*. Reef patches such as the Soatoi Reef, several smaller patches, the quarantine island, Motu Uta, etc., were all built up from the bottom of the moat by this slender upright finger coral and owed their vertical sides to its distinctive growth form. The inner wall of the moat is the outer wall of the protected fringing reef which extends inland to the base of the cliffs or steep slopes of the volcanic portion of the island. This will be discussed in the following paragraphs.

FLORAL RELATIONS OF THE PROTECTED FRINGING REEFS

The protected fringing reefs occur within the barrier reefs and most of them have a long history, since they have extended out from the bases of the lower or higher cliffs or slopes to form the basis of the coastal plain. It is only the outer edge, projecting beyond the coral sand or rubble generally mixed with water-worn or otherwise disintegrating talus of volcanic rock, that is now readily observed. The protected fringing reef is seldom laid bare at low water, or if so, only the innermost portions of it, but is always covered by a foot or more of water even at the lowest tides. While the protected fringing reef may probably have begun its existence as an exposed fringing reef and have shown the structure, to be indicated later on, of that type of reef, the growth shown at present is more like that of the protected side of the barrier reef and has been brought about by the development of the barrier reef from a barrier bank to a true reef, thus protecting the inner reef from any considerable or constant wave action. The margin of the protected fringing reef shows no Porolithon belt nor does it possess any continuous lepyrodolithako-heliazophyte pavement, but is covered with stout *Acropora* and *Pocillopora* rosettes of cristate coralla, never, or at least extremely rarely, completely uncovered. These coralla are of various shades of brown, amethyst, or red when in living condition. They are thickly placed and walking over them is usually difficult. Within the marginal belt of thickly placed coralla, occur scattered corals, filamentous and other algae, and finally, a wide space shoreward is fairly smooth, somewhat deeper, and covered with more or less silt from land drainage. Encrusting *Melobesia*e, mostly thin species, abound here, but, except for the inner reef flat, occur spot-wise. The inner shallow portion of the reef flat shows almost continuous flooring of *Melobesia*e under loose silt on which *Caulerpa sertularioides* may occur and various other algae, such as species of *Polysiphonia*, *Dictyota*, *Padina*, *Cladophora*, *Enteromorpha*, *Hydrocoleum*, etc., which prefer shallow quiet water. Clumps of *Halimeda* species may also be found in such situations, and where shade was provided by overhanging trees, *Murrayella squarrosa*, growing on small stones. Once we found an abundance of *Asparagopsis Sanfordiana*, thickly infested with the inconspicuous *Lyngbya epiphytica*, floating in such shallows, suggesting that in the warmer

season a more considerable flora of delicate red algae might be present. The protected fringing reef was studied more particularly at Auae, on the outskirts of Papeete, than elsewhere.

FLORAL RELATIONS OF THE EXPOSED FRINGING REEFS

Exposed fringing reefs, usually of small superficial area, are to be found along the northern and northeastern coasts of Tahiti, where barrier reefs are replaced by barrier banks. Much of our attention was devoted to these reefs since they were more readily accessible than the barrier reefs and possessed a much richer flora than either the barrier or the protected fringing reefs.

Excellent examples of small exposed fringing reefs were found at Arue Point and on the southwest side of Tahara Mountain, and since these were only a few miles from Papeete they received the greater amount of our attention. Still smaller reefs were found at various places along the northeast shore between Papenu and Huau (cf. Chart 2025, Hydrographic Office, U. S. Navy) and were studied from the point of view of being incipient reefs of this type. The growth of exposed barrier reefs has already been described (cf. Mayor, 1920, pp. 224-236; Setchell, 1924, pp. 28-31) and its chief characteristics emphasized. The distinguishing feature of such a reef is its overhanging margin. This is the result of the outward growth of the *Porolithon onkodes* association to which the inception and continuance of this type of reef is due. It seems evident from a study of this type of reef both on Tutuila and on Tahiti, that it extends out somewhat above mean low tide level as a sort of shelf and accumulates materials below itself from the corals which grow in its shelter and the coral and other talus which accumulates below it which is cemented together by means of crustaceous and calcareous Squamariaceae as well as of Melobesieae. I shall return later on to a consideration of the development and growth of the exposed fringing reefs. At present I shall confine myself to a brief discussion of their floristic features and those of topographic distribution of the floral elements.

Exposed fringing reefs show distinct belts arranged and constituted much as is the case with the barrier reef. The differences in belting between these two types of reef result entirely from their different contour. The barrier reef slopes both ways from a ridge. The exposed fringing reef, whose surface in these small reefs on Tahiti is almost entirely exposed at periods of low water, is nearly level or

somewhat depressed between the inner and outer margins. I found no such pronouncedly deeper depression, which I have called the "reef moat" (cf. Setchell, 1924, p. 32) in the Tahitian reefs although such were found in the much wider and presumably older exposed fringing reefs of Tutuila. Various agencies, not as yet operative in Tahiti, have brought about the Tutuilan "reef moats." The outer margin of the exposed fringing reef overhangs and is a pure *Porolithon onkodes* association, extending down over the reef rim a foot or somewhat over and back from the margin, forming a pavement-like outer belt. Within this belt is a broad, continuous or interrupted Sargassoid belt, as on the barrier reef, but in the exposed fringing reef it is often mingled with or largely replaced by other but similar brown algae. While this belt on the Tahara Reef is largely made up of *Sargassum* (several species) and *Turbinaria ornata*, on portions of the Arue Reef these are replaced, at certain seasons at least, by *Hydroclathrus clathratus* and *Chnoospora pacifica*. Within the Sargassoid belts occur mixed associations, varying much on the different reefs. The extreme innermost area, at least of the broader reefs, is usually raised and barren, consisting ordinarily of basaltic pebbles or debris thrown up and cemented together by lime deposited through evaporation. The mixed associations yield many species of algae, growing exposed on the Porolithon or in hollows or small shallow pools, of which there are many on the reef surface. The exposed fringing reef has connection underneath the surface layer of Porolithon and overgrown rosette corals with the outer water which comes spurting up in unexpected places far in from the rim as the waves dash over the reef margins. Various pholadophytes snuggle in the hollows, lepyrodo-phytes of the skiarophyte type grow underneath the crust in favorable places, and tranobions or boring organisms are abundant. The tranophytes of all the reefs have not yet been completely identified since, while present, they are often to be obtained only in imperfect or unidentifiable form. It may be said, however, that species of *Gomontia*, *Ostreobium*, *Mastigocoleus*, *Plectonema*, and *Hyella*, the usual tranophyte genera, are present.

On some of the smallest of the exposed fringing reefs there are to be found, well inside the naked Porolithon rim, distinct associations of the wiry *Laurencia flexilis*, over which, on which, and among which are delicate green algae, *Dictyota* species, clumps of Caulerpae, applanate species of *Codium*, etc. In small "pot-hole" like depressions on the reef, or covered under dense growth of *Sargassum* or *Turbinaria*,

were numerous small skiarophile pholadophytes, such as *Valonia ventricosa*, dichotomous erect or repent species of *Codium*, *Caulerpa Webbia*, and lepyrodophytes, such as *Zonaria variegata*, *Aglaozonia pacifica*, and encrusting species of Squamariaceae and Melobesieae.

FLORAL RELATIONS OF BASALTIC SHORES

There was no such difference between the plant cover of reef and basaltic shores in Tahiti as were found in Tutuila (cf. Setchell, 1924, p. 33). The same species as a rule occurred on both calcareous and basaltic substrata, the former, however, seeming to be neither so shining nor so intensely white as the similar reef localities are on Tutuila. *Avrainvillea lacerata* is the only species seeming to select basaltic substratum but, as this also appeared to be decidedly skiarophile, occurring in a deep, dark "pot-hole," the light factor may well have been unusually influential in this case; also this species may have chosen a similar pholadophyte locality on the reef without our detecting it.

ECOLOGICAL RELATIONSHIPS OF THE MARINE FLORA

It has seemed desirable to indicate by reasonably intelligible, although somewhat cumbersome designation, certain morphological and ecological types, particularly in connection with reef-discussion. This was begun in connection with the reef work on Tutuila and Rose Atoll (cf. Setchell, 1924). I have found similar reason for continuing the practice in connection with the work in Tahiti.

The morphological terms such as chordophytes, lithakophytes, lepyrodophytes, etc., emphasize the relation between external form or habit and various external factors such as stresses and strains of current and surge, as well as certain light relations, particularly the avoidance of intense illumination on all sides. Chordophytes are plants of string or cord-like habit, the different axes collapsing together under stress so as to present little resistance to a flowing force. Usually this character is associated with slipperiness. The lithakophyte is of stony consistency, rigid, or when jointed, flexible, to resist tearing stress, but shattered by a blow. This is primarily the characteristic of the corallines so common on the reefs. Lepyrodophytes are crustaceous forms, usually prostrate and often attached over all of their lower surface. They are little affected by wave flow or current flow and present only one surface directly to the light.

The cumatophytes are already understood as being plants growing in surge, presumably requiring a considerable degree of aeration. Such plants as grow on the barrier reef and on the outer belts of the exposed fringing reefs are true cumatophytes and the cumatophyte belts are definitely delimited.

Metarrheophytes are fluctuating plants, so constructed as to extend out into currents, doubtless for aeration. Such plants as *Bryopsis Harveyana* are typical metarrheophytes.

On the reef it seems very necessary to distinguish between the sun-loving heliazophytes and those that seek the shade, skiarophytes. Even the sun-loving heliazophytes may avoid too great illumination, at least from all sides, and may, like the lepyrodophytes, be able to do so because of their morphological peculiarities; or they may snuggle into hollows as do the pholadophytes. The skiarophytes, when living under surface conditions, are often pholadophytes.

Epiphytes are generally known since the term has had long usage and epiphytes are commonly represented among the algae. The same is true of endophytes, of which a few living within the layers of the cell membranes occur in Tahiti. No truly parasitic algae have as yet been found in Tahiti, and herpophytes, dwarf plants, were not so commonly met with on the reefs of Tahiti as was the case on Tutuila. Tranophytes, or boring plants, are common but, as has been stated, have not yet been fully studied.

The discussion of the terms given above indicates generally the relations between various factors of reef and other shore forms and the factors especially concerned. As to temperature, the marine algae of Tahiti are all truly tropical species, requiring a temperature of 25° C, or above, for continued existence. None of them seem to require temperature below 25° C, although some of them may be able to endure such a temperature for short periods. In shallow pools, impounded water may become so warm as to kill marine animals in them as well as some of the algae.

Tropical species of marine algae are smaller in size on the average than those of other zones. Very few tropical algae are conspicuous but species of *Sargassum* or other brown algae may grow to a foot or more in length. The rule, however, is much less than that. A Porolithon association may be considered as being made up of comparatively few plants and the area covered by the derivative from a single spore may possibly amount to many hundreds or even thousands of square feet. Such a conception is possible, even very probable, and if taken to

represent the actual condition in a reef cover of many miles long and 150 to 200 feet wide, especially if conceived of as having arisen from comparatively few centers, would require individual plants of a size unequaled elsewhere in the entire vegetable kingdom and of an age comparable only to that assigned to divisions of geologic time.

FLORAL RELATIONS IN BARRIER BANKS

On this important matter we have no data. Alexander Agassiz, sailing over the Dolphin Bank, reports (cf. A. Agassiz, 1903, p. 155) that it seemed largely made up of nullipores (*Melobesieae*).

THE CORAL REEFS OF TAHITI

FROM THE POINT OF VIEW OF THEIR RELATION TO THE MARINE FLORA

A coral reef is a symbiotic entity with definite origin, growth, and capacity for morphologic change, and having its upper surface at or very near sea level. Although composed of heterogeneous and seemingly discordant elements, it remains a unit and presents, in a certain way at least, many of the distinctive characteristics of an individual organism. Theories as to the origin and the relation of origin to final (or progressive) form have regarded the reef as a distinct organic entity, but little that is constructive has been determined either as to the earlier stages of development or as to the relations of coördination existing among its heterogeneous elements. Coral reef theories have tacitly assumed, or seem to have done so, the necessity for interconvertibility of fringing and barrier reefs without the slightest idea of their organic structure or development. In the theories corals are simply corals, and while distinction is drawn between corals and reef-forming corals, there is little to distinguish the two groups except that one set forms reefs and the other does not. There is little in the literature as to what corals do in reef formation except to form it, yet a coral reef is sufficiently compact and united to stand wave and storm and form a projecting shelf on a shore exposed to violent wave action, or a more or less complete circle about a high volcanic island, or a similar construction devoid of an island center in mid-ocean. Cohesion is something more than can be produced by any other than very few reef-forming corals. There must be some sort of a binder to hold the

different coralla together to form such a structure as a coral reef, no matter of what type it may happen to be. The attention of those earnestly searching for the truth in each or every one of the coral theories proposed has been turned more and more toward this point. This matter has also been seen, at least dimly, to be associated possibly with the question as to the element in a coral reef which determines its form. The various investigations at the Chagos (cf. Stanley Gardiner, 1905, p. 571), the Maldives, and Laccadives (cf. Stanley Gardiner, *in* Foslíe, 1903, p. 463), Funafuti (cf. Finckh, 1904, pp. 125-150), etc., have called attention to the work of the nullipores (Melobesieae, at least in larger part), in both of these important matters. Foslíe (1903, pp. 460, 461) states that "the Challenger Expedition met with a bank off Tahiti, which had probably been formed by a single species, *Lithothamnion Dickiei*." M. A. Howe (1912) has summarized the situation and I have added (cf. Setchell, 1924, p. 243) evidence from Rose Atoll in the Samoan groups.

The influence of the nullipores (as I shall call the Melobesieae or crustaceous corallines), both as reef-builders and reef-shapers or reef-formers, is in fair way to be recognized. Corals contribute bulk and in many or most reefs this is considerable, yet there are reefs, particularly atolls, such as that of Rose Atoll, that of Onoatua (in the Gilbert group) and those of the Chagos, where the nullipore alone is the only visible component. We know little of the lower portions of reefs although borings have been undertaken, but in the results from the Funafuti borings it seems clear that the content of nullipore, as shown by the proportion of magnesium to calcium, increased downward (cf. J. W. Judd, 1904).

One ecologic matter connected with corals has been carefully considered and is the keynote to, or the prop for, practically all coral theories, and that is that reef corals do not grow deeper than two hundred feet below the surface. Upon this seemingly fundamental fact has arisen the idea that coral reefs can be formed only in comparatively shallow water. The fact that most of them arise, or certainly seem to arise, from a greater depth has seemingly made necessary some explanation of a change of water level, such as that expressed in the gradual subsidence element and the necessary interconvertibility of fringing and barrier reefs of the Darwinian and similar coral reef theories. Such need does not necessarily arise in the case of Rose Atoll, Onoatua, the Chagos reefs, etc., since, to all appearance they are not built of "reef-forming" or of any form of

coral. The same idea may be applied to the lower portions of the reef at Funafuti and probably to all reefs of extreme thickness.

The restriction of corals of such size and massive structure as to be of importance in building up a coral reef to the upper two hundred feet of ocean depth seems to be confirmed (cf. Vaughan, 1907, pp. 32-35). On the other hand, the nullipores (cf. Finckh, 1904, p. 134) have been obtained ("lithothamnium") from 1200 feet at Funafuti, but of entirely different species from those of the littoral belt, and agreeing better with those from depths of 240-500 feet and more where they were more common. These investigations seem to eliminate thoroughly the coral limitation as applied to coral reefs in that corals are not to be considered as essential to reef formation since they are lacking in some reefs, and in the bases of all reefs of any thickness are minor elements or even lacking. Elimination of the coral and substitution of the nullipore removes depth limitation, so fundamental in subsidence theories. From various observations (cf. Mayor, 1924, pp. 11, 12), it seems probable that the rosulate and rosette coralla-forming species of corals so important in reef formation are largely confined to within twenty-five to fifty feet of the surface. Alexander Agassiz (1903, p. 150) seems to have enjoyed unusual facilities in examining the seaward face of the barrier reef off Papeete and he found coral conditions very different from those described in the Narrative of the Challenger Expedition (1885, p. 777). Agassiz is very definite that living corals extended as a rule into water of only four to six fathoms.

The second condition of coral reef theories, particularly those requiring gradual subsidence of land or, conversely, gradual rise of sea level, is the necessity of interconvertibility of different topographic types of reef; e.g., the conversion of fringing into barrier reefs as subsidence proceeds, presumably slowly and in a regular fashion. Through subsidence, the fringing reef is supposed to become a barrier reef and the barrier to become, on complete subsidence of the land mass about which reef formation is taking place, the circular or enclosing reef of an atoll. It is unnecessary to go into the various forms of this variant in coral reef theories, but simply to point out this condition in connection with the suggestions already outlined as to the origin of the reefs and banks of Tahiti. As has already been stated, it seems best to consider these features of Tahiti as classified into barrier reefs, barrier banks, exposed fringing reefs, and protected fringing reefs. The barrier reefs and the

barrier banks are so similar in position, depth relations, and form that it seems impossible to consider them other than different expressions of the same formational type. They occupy the same encircling belt, rise from approximately the same depth, are interrupted by the same type of "pass" as breaks in their continuity. The difference is that the barrier reefs have risen to the surface while the barrier banks have their surfaces at some appreciable although not uniform depth below the surface. These differences seem due to age and the existence of some inhibiting conditions for inception or retarding conditions for growth on the barrier bank sectors. Since these sectors are at what may be thought of as the ends of the fissure of eruption, it may be suggested that the cliffing prominent along the coast in these sectors and the tuff cones and late dikes at Tahara Mountain (near the Dolphin Bank) may indicate a later cessation of minor volcanic activity or of cooling and rock disintegration in these sectors and consequent retarding of coral bank inception and progress in development. Alexander Agassiz (1903, p. 153), however, considers the Toa Tea Reefs to the westward of Point Venus and opposite the eastern portion of Matavai Bay "as the remnants of a former barrier reef" and consisting merely of "patches of nullipores with here and there diminutive coral heads which have taken no part in the building up of these reefs."

There are, however, complete barrier reefs to the westward of the Toa Tea and on the similar exposures of the Island of Moorea, and the opinion of Agassiz does not seem to be supported. Consequently the ecological element so important in subsidence theories is not an essential element.

The barrier structures, both reef and bank, seem of most ready explanation on the line of zonation, due to depth relations of light and temperature, particularly of the latter, such as Vaughan (1907, pp. 23-32) has shown in connection with corals and which also hold for mollusks, Alcyonarians, and nullipores. Judging from the charts, a ridge formation of shells, nullipores, and an occasional coral may have started between thirty and forty fathoms, possibly also assisted by some peculiarity of the talus formation. In this connection I may recall an observation of importance. David, Halligan, and Finckh, in their Report on dredging at Funafuti (Rept. Coral Reef Comm., Roy. Soc., p. 153, 1904), call attention to the presence of "living horny alcyonarian corals, belonging to the Gorgonidae" on the steep slope (at an angle of 70°) between 40 and 100 fathoms in sufficient

abundance to form a low scrub and to the probability of their playing an "important part in arresting the sand and fine rubble in its downward progress." Similar zonation at varying depths occurs and assists in forming horizontal (encircling) ridges which, when once started, may well form the earliest inception of a barrier or atoll reef. The upward growth of such a ridge might proceed more or less continuously or interruptedly to the surface in the case of the barrier reef and be still progressing upward in the case of the barrier bank. In a preliminary report (cf. Setchell, 1922, p. 181) I suggested a wave bench at a depth of approximately two hundred feet from which the barrier reefs and banks may have risen and such a wave bench may still be borne in mind. Such a modification of the submerged slope of Tahiti is suggested by cliff and reef structure, but later study leads me to believe the explanation of encircling reef and bank inception and progress as a function of zonal distribution to be adequate and that of a broader or narrower wave bench, while possible, need not be considered as necessary for the explanation of the present conditions. In either case, harmony with the essentials of Daly's Glacial Control theory is also possible. Whether or not the encircling barrier reef and bank is supposed to be associated with a previously existing fringing reef, it seems certain that it has not been so associated in the sense of incontrovertibility. The barrier reef and bank may have been built up on a previously existing fringing reef, not as part of the latter's growth, but later, after it had been submerged, i.e., in definite nonconformity with the reef. It seems clear that the barrier formations have no genetic connection with the present fringing reefs, either exposed or protected. The hypothesis that these reefs have grown up independently of fringing reefs and from a depth of thirty fathoms or more seems to be consistent with their position and structure.

The fringing reefs about Tahiti are probably alike in origin and earlier history, becoming differentiated later into the exposed and the protected. From the general structure and from observations on some of the smaller fringing reefs on exposed shores, it is clear that these reefs extend out as shelves and at the level of mean low water or just above it. The incipient agencies are rosulate or rosette corals, such as species of *Pocillopora*, *Acropora*, *Pavona*, etc., and the massive encrusting *Porolithon onkodes*. These are the controlling organisms. Through the protection of, as well as débris from, these organisms and those gradually associated with them, there are built

up the fringing reefs with projecting rims. Such is the process on exposed shores. I surmise that the protected fringing reefs have begun existence as exposed fringing reefs before the barrier banks forming opposite them have reached the surface. After the barrier reef has reached the surface, upright slender finger corals (*Porites* spec.) form both along the outer front of the then protected fringing reef and along the inner front of the barrier reef and extend from both inward into the lagoon moat, forming its vertical walls and in some cases obliterating it and causing fusion of fringing and barrier reefs. Reef patches due to upward growth of finger corals occur within the lagoon moat and may assist in the coalescence of fringing and barrier reefs. Cases of fusion, whether due to such growth or to local changes of one kind or another, are known along the west and south coasts of Tahiti from Taapuna Pass to Port Phaeton (cf. also Alexander Agassiz, 1903, p. 147).

The general barrenness of lagoons of atolls and lagoon moats within barrier reefs as to both corals and nullipores due undoubtedly to unfavorable growth conditions for either or both forms, may be taken into account in discussions as to the reasons for their existence, form, and depth relations. The nearly uniform depth of lagoon structures has caused much discussion, but zonation, with barren areas (or at least provided with different growth forms and those little effective in the deposit of lime) within the region of active life or growth, seems likely to prove the fairly simple solution of this very important attendant circumstance of reef formation.

In the foregoing paragraphs I have attempted to outline reasons for considering that the outstanding biological consideration of most coral theories is not justified. The rise of a coral reef from deep water seems not only possible but extremely probable, through the growths of nullipores, either unaided or aided particularly in the upper few fathoms by coralla of definite types of growth form. I have also attempted to show that it is not necessary to assume interconvertibility of reef forms, since, if my observations are correctly interpreted, barrier banks pass into barrier reefs and exposed fringing reefs arise independently and are modified into protected fringing reefs when the outlying barrier reaches the surface and induces quiet water conditions within its natural breakwater.

Any discussion, such as the foregoing, of the origin and growth of coral reefs naturally leads to a consideration of the reef-formers or builders and to an estimate of the age or ages of the coral reefs concerned. I shall attempt to consider each very briefly.

REEF-FORMERS AND REEF-BUILDERS IN TAHITI

The conspicuous reef-former, both on the barrier reefs and on the exposed fringing reefs, is *Porolithon onkodes*. The extensive pavement-like crust of this species is practically continuous along the surface of each segment of the barrier reef from one end to the other, a distance of several miles in most cases. It also reaches a width of two hundred feet or more. The same species forms at least the marginal belt of exposed fringing reefs and in the smallest reefs may cover the entire upper surface. It is exposed to the full force of the breaking waves and is undoubtedly of the utmost importance in protecting the reef surface as well as in shaping and extending it. Underneath it seems to be disintegrated and decomposed by tranobions (boring annelids, boring algae, etc.) as it increases in thickness above. Its rate of increase in thickness and possibly also in marginal growth is about one-fifth to one-third of a millimeter per year (cf. Setchell, 1924, p. 35). Below the surface of the barrier reef for a distance of twenty-five feet or more, the increase in thickness and at the margin is due to both corals and nullipores as has previously been indicated. These nullipores are usually thinner and less extensive than the reef-formers, but their lack of bulk is compensated for by that of the coralla of the various species of *Pocillopora*, *Acropora*, *Pavona*, *Porites*, etc. Below these, in turn, the nullipores are probably predominant, mostly of different species from those of the upper portions. But exact data are lacking, since no borings have been made.

Porolithon onkodes is the most conspicuous of all the reef-formers on the reefs of Tahiti, but the less conspicuous and unidentified *Melobesia*e, or nullipores, of the deeper portions of the barrier reef must also do an almost incredible amount of bank-building and controlling. The other prominent reef-builder and reef-former of the Indo-Pacific region is *Porolithon craspedium*. This species is held responsible for at least the upper portions of the encircling reefs of such atolls as Rose, Onoatua, and those of the Chagos. It is reported from Funafuti, but *Porolithon onkodes* seems to be the present dominant on the reef margin in that atoll. *P. craspedium* is also credited to Tahiti (cf. Lemoine, 1911, p. 165) but I suspect that the exact locality may be some atoll in the Tuamotu, since I have searched for it in vain on the reefs of Tahiti.

AGE OF THE CORAL REEFS OF TAHITI

While one may consider the possible age of a coral reef, it is a matter involving many factors as yet not susceptible of exact measurement. If we consider the growth of the nullipore to be possibly some indicator of progress, then we may suggest that the upward growth of the barrier reef may have averaged from one-fifth to one-third of a millimeter, per year. If we also imagine that the depth from which the barrier reef arises to be about thirty fathoms (or sixty meters), then the simple calculation of 180,000 to 300,000 years seems probable. The latter figure may be much too long, and possibly even the former, but I doubt that even the larger figure can be adequate for producing a reef of the height and breadth of the barrier reefs of the Society Islands. Any such attempt to assume a uniform growth rate for either an upgrowing or an outwardly extending reef is subject to extreme doubt and the upward growth for the last twenty-five or fifty feet is likely to be much more rapid, on account of the coral admixture. It may be said, however, that over each set of coralla there must needs be a growth of nullipore to bind the coralla together and to make a proper and smooth substratum for the growth of more coralla. The difficulty with estimates from coralla is that they are based largely upon those of comparatively shallow waters and the estimates apply only to the uppermost portions of a reef where degradation is probably also very considerable. While the nullipore estimate is probably moderate to very large, the coral estimate may probably be far too small, at least for a reef of any thickness.

In connection with the possible age of the barrier reef of Tahiti, there arises naturally the question of its geologic age. It is assumed that the volcanic rocks are Tertiary but no fossiliferous deposits of any kind are found nor is there a trace of any emergent reef. An emergent reef exists, for example, on Oahu, with its upper limits twenty to twenty-five feet above tide level. Such a reef as that of Oahu may have been pre-glacial in the sense of Daly and similar in age to the reef of the same elevation in Fiji (cf. Guppy, 1903, pp. 8, 9). The absence of reef corals on Tutuila before the six-meter (eustatic) lowering of sea level represents according to Daly (1924, p. 128), "an important problem not yet solved." On Tutuila, Daly finds the six-meter level well represented and there are traces of something similar in a few wave benches and arched rocks on

Tahiti. The fossil mollusks of the Oahu reef are mostly those of the present reef (now dead), except a few absolutely extinct species and a few now seemingly extinct in Hawaii but flourishing in warmer parts of the Pacific or Indian oceans. The reefs of Tahiti, formed as they seem to have been on the shores of an island without trace of coral reef organisms above the present sea level, were probably built up largely at least since the glacial period and the barrier reef, as it now exists, may possibly rest on a wave bench formed previous to or during that period. Such speculations however, demand more geological study and knowledge than is possible or available at time of writing.

SUMMARY

1. From a consideration of the marine vegetation of Tahiti, it is found to indicate that:

(a) There are no marine spermatophytes known from Society, Marquesas, or Rarotonga.

(b) That 149 species of marine algae known from Tahiti do not include species of any of other than widely distributed genera.

(c) The 149 species of marine algae are mostly either widespread or Indo-Pacific.

(d) There is very little representation of a distinctive Atlantic American element.

(e) The endemic element will probably be found to be more widespread at least in the tropical Pacific.

2. The widespread genera of tropical marine algae, now discontinuous in distribution, are probably old in geological time, many or most possibly dating back at least as far as Jurassic or Cretaceous, and that their wide distribution was accomplished between that time and the Tertiary, during periods of more or less broad oceanic connections.

3. Some of the discontinuous distribution of species may have taken place earlier and some later, some even during the Tertiary.

4. The known marine algae of Tahiti are practically all of the littoral zone, with the exception of some Melobesieae and Squamariaceae.

5. The different ecological forms and ecological behavior of the Tahitian marine algae are the same as was determined for the marine algae of Tutuila and of Rose Atoll.

6. The calcareous crustaceous algae (nullipores) are primarily concerned in building up the "coral reefs."

7. The reefs of Tahiti may be classified as barrier reefs, exposed fringing reefs, and protected fringing reefs.

8. There exists on the shores of Tahiti "barrier banks" similar in position to the barrier reefs, and these may develop into barrier reefs.

9. Barrier banks and barrier reefs may originate independently of fringing reefs, rising from depths even greater than those assigned as limiting "reef-forming" corals and growing upward toward or even to the surface.

10. Barrier banks and reefs may represent only the effect of ecologic factors known as zonation, or perhaps may grow from a broader or narrower wave bench.

11. Such growth of barrier reefs is inconsistent with the fundamental assumptions of depth relation and interconvertibility of coral reef theories.

12. The fringing reefs originate as projecting ocean surface shelves, extending their margins and filling in below, and, when later "protected" by the growth of barrier reef, cease this form of growth and become modified along their outward fronts by the vertical growth of a slender upright cylindrical finger coral (*Porites?*).

13. The vertical walls of the lagoon moat are due to the coral growth form just mentioned.

14. Fringing and barrier reefs coalesce across the lagoon moat by the growth of reef patches and extending fronts due largely to the increase of the same coral growth form.

15. The reef-formers proper are nullipores, the most conspicuous being the widespread crustaceous *Porolithon onkodes*.

16. The second conspicuous reef-former of the Indo-Pacific region, the fruticulose branched *Porolithon craspedium*, although credited to Tahiti, could not be found, and is probably characteristic of atolls.

17. Estimating from the rate of growth of nullipores, the barrier reef of Tahiti may be from 180,000 to 300,000 years old.

18. Relying upon the absence of elevated coral reefs, the present reefs of Tahiti may all be considered to be postglacial.

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CONCLUDING NOTE

The foregoing article completes the series of reports resulting from the botanical expedition of Clara B. Setchell, Harold E. Parks, and myself to the Island of Tahiti in the year 1922. I am deeply indebted both to those who have prepared reports and to those who have assisted and cooperated in furnishing information and advice as indicated in the first seven papers of this volume. A report on the Hepaticae of the expedition was in preparation by Mr. William Henry Pearson of Manchester, England, but was interrupted by his brief final illness and untimely death. I desire, also, to acknowledge the very welcome financial assistance received from the Carnegie Institution of Washington through the recommendation of the late Dr. Alfred Goldsborough Mayor, Head of the Department of Marine Biology.

WILLIAM ALBERT SETCHELL

FIJI PANDANACEAE

BY

UGLINO MARTELLI

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When I published in Webbia, vol. 3, 1910, the Enumerazione delle Freycinetia, and, in 1913, that of Pandanus, concerning the Pandanaceae of Fiji Archipelago, there was known only the species that had been published in the classic Flora Vitiensis, by Seemann, besides the specimens existing in the herbarium at Kew and in the private one belonging to the late Miss Lily Gibbs; in all, five species of *Freycinetia* and three of *Pandanus*. So far as I know, almost no other Fijian Pandanaceae are to be found in any herbarium. Persuaded of the importance and peculiarity of the flora of that region, I tried in several ways to see to it that botanical collections might be made on my account on those islands, but I did not succeed in finding anyone who would take that charge. Now kind Dr. E. D. Merrill (then Dean of the College of Agriculture of the University of California at Berkeley), whose acquaintance I had the pleasure of making some years ago in Florence, has asked me to study the Pandanaceae collected in Viti Levu Island during the year 1927 by Messrs. J. W. Gillespie and H. E. Parks on behalf of the Bernice Pauahi Bishop Museum of Honolulu and by Professor W. A. Setchell in 1926. Of these I now have the pleasure of giving an account, and of returning my grateful and best thanks to Dr. Merrill.

The collection contains twenty-two numbers, all from Viti Levu Island. Besides the specimens already known, which thus become even better illustrated, there are also four species not yet known to science.¹ If the botanical collectors had visited other islands of the group, I am sure their trouble would have been rewarded by the discovery there of many additional novelties. I hope that the good example of Messrs. Parks and Gillespie will be followed and that it may encourage others to undertake new botanical researches through that archipelago. I beg them not to neglect the Pandanaceae, of which, if we still lament sparse notices in comparison to other families, it is only because good material concerning them is wanting among collections.

¹ The new species here described are five, because the *P. Graeffei*, described by me some years ago, I never published.

PANDANACEAE PREVIOUSLY KNOWN FROM FIJI

1. *Freycinetia caudata* Hemsl.
2. *Freycinetia Milnei* Seem.
3. *Freycinetia Pritchardii* Seem.
4. *Freycinetia Storckii* Seem.
5. *Freycinetia vitiensis* Seem.
1. *Pandanus Joskei* Balf.
2. *Pandanus Thurstonii* Wright (= *P. caricosus* Seem.)
3. *Pandanus odoratissimus* Linn. (= *P. verus* Seem.)

***Freycinetia vitiensis*, Seem. Fl. Vit.**

No specimen of this *Freycinetia* is in the collection.

***Freycinetia Graeffei* Mart. n. sp.**

Plate 37

Caulis tenuis levis, in sicco costulatus 4–5 mill. crassus, internodiis brevibus, 4 mill. longis. Folia ad apicem ramorum inter se approximata et imbricata, recta submembranacea, anguste lineari-lanceolata, 3–7 mill. lata, 20–35 cent. longa, apicem versus attenuato-acuminato-subulata, basin versus sensim angustata et breviter canaliculata, ima basi dilatata, semiamplectentia haud inguainantia; auriculis membranaceis, 1.5–2 cent. longis, angustis, lanceolato-acuminatis, cito in fibras solventibus; lamina foliae utrinque crebre longitudinaliter venata; marginibus in parte basilari et apicali, brevissimospatio tantum, subulato-denticulatis; costa media, in parte basilari et apicali, remotiuscule minute denticulata. Inflorescentia ♀ duplex (semper?), pedicellis 2.5–3 cent. longis, 2–3 mill. crassis, apicem versus et secundum tres costulas, setososcabridis. Syncarpia oblonga vel subglobosa, 17 mill. longa, 13–15 mill. diam. Baccae parvae, sublagaeniformes, 5–7 mill. longae, 3 mill. latae, fere dimidia superiore parte liberae et in parte apicali 2 mill. longae, prismaticae, subcorneae, vertice truncato, 1 mill. lato; stigmata 4–5, semina ovata vel obovata, 1 mill. longa, fere ½ mill. lata.

Habitat.—Fiji Isl. Namusi. Graeffe, 243, a Ovalau; Graeffe, 1192, in Herb. Hamburg. Fiji Isl. J. Horne, 1877–78; 844 and 903, in Herb. Petropolitano. Colo i Suva, thick forest. Vine 10–15 m. long, climbing over trees; Parks, Plants of Viti-Levu, June, 1927; 20083 and 20955 ♀. Tamavua Road, W. A. Setchell and H. E. Parks, Plants of southeastern Viti-Levu, 22–28 May, 1926; 15102 ♀; and Tamavua-Sawani Road, at about 200 m. alt., Setch. et Parks., 15119 ♀, in thick mountain jungle. On bank of stream, vicinity of Wairiki, alt. 200 m., J. Gillespie, 4721 (sterile).

Observations.—This is near to the *Freycinetia vitiensis* Seem. but has much longer leaves and the syncarp is much larger and composed of a greater number of berries which are much bigger and of a different shape. In the *Fr. vitiensis* the berries are ovate-acuminate, but in our species, near the center, they become larger; from there to the apex they are pyramidal and slightly costulate, and each smallest rib corresponds to a lobe of the stigma. The berries, from the middle to the base, are obpyramidal; thus of a form quite diverse to that of the berries of the *Fr. vitiensis* Seem. The peduncle of the fructifications is also differently bristled and thinner. I had already noted this species in the herbarium of the Hamburg Botanical Gardens, gathered in Viti Levu by Graeffe (243) at Namusi and at Ovalau (1192 sterile). Mr. Horne had collected the same species in Fiji in 1878–79. His specimens I saw and they are to be found in the St. Petersburg herbarium under the name of *Freycinetia vitiensis* Seem. It seems that the syncarps vary in size and thickness. I have seen both small ones and very large ones. The small ones are more oval, like those of the *Fr. vitiensis* Seem., but the leaves are always quite different.

***Freycinetia caudata* Hemsl.**

Kew Bull. 1896, p. 167

Caulis tenuis 4? mill. crassus, angulosus, internodiis 6–10 mill. longis. Folia in apice ramorum adunata, submembranaceo-consistentia, lineari-lanceolata, 1 cent. lata, basin-versus $\pm$ longe attenuata et acute plicata, ad apicem sensim attenuata et longe subulato-acuminato caudata; lamina utrinque longitudinaliter venis percursa; in pagina inferiore venulis prominulis (sub vitro), lepidata, et parva distantia transverse venulata; marginibus, in ima basi, interdum in extremo apice et in cauda semper minute denticulatis; costa media filiformis e medio ad apicem distante, minutissime spinuloso-dentata; auriculis 2–2.5 cent. longis scariosis et cito in fibras solutis angustis basim fere 3 mill. latis sensim lanceolato-acuminatis. Inflorescentia σ terminalis, terna, tribracteata, bracteis longissimis 7–11 cent. et 12–14 mill. latis ad basim, lanceolatis sensim attenuatis, longe acuminato-subulatis, navicularibus; marginibus et carina, in extremo apice tantum, spinuloso-dentatis. Pedunculus brevissimus; cum pedicellis tribus, circiter 1 cent. longis, 1.2 mill. crassis, glabris; parte staminifera elongata, 27–35 mill. et circiter 2 mill. crassa, columnae antheriferae brevissimae, tripartitae e pulvinis lanosis, emergentes.

Habitat.—Fiji Isl., Viti-Levu, Colo—North, Nadarivatu, valley of the Sigatoka River, 900 m. alt. J. W. Gillespie, Nov., 1927, Pl. of Fiji; 3882 ♀, and 3167 ♂—. Near stream vicinity of Nasinu, 9 miles from

Suva, 150 m. alt. Naitasiri Prov.; Oct. 22, 1927. Gillespie, 3461 ♀—Nadarivatu, slope of Loma laga mountain, alt. 1100 m. Gillespie, 3685 ♀.

Observations.—This varies in the size and shape of the leaves, which are always lanceolate but more or less gradually attenuated and canaliculate toward the base; toward the apex they are attenuate into a long tailed acumen. Sometimes they are abruptly caudate. They vary also in consistency, being at times membranaceous, at other times slightly coriaceous.

***Freycinetia Pritchardii* Seem.**

Fl. Vitien., 1865-73, p. 283, tab. 84.

Caulis 7 mill. crassitudine ad extremitatem ramorum; internodiis brevissimis, 4-5 mill. longis. Folia ad apicem ramorum coriacea, linearia, circiter 30 cent. longa, sensim attenuato-acuta, basi, brevispazio, plicato-canaliculata, amplexentia, lamina utrinque longitudinaliter crebre venulata, in pagina inferiore (sub-vitro) aliquantum manifeste lepidata; marginibus, in parte apicali et basilari tantum, paulum et remote denticulatis; costa media angusta sed prominenti, e medio ad apicem remote brevissimo spinulosa; auriculis cito consumptis, membranaceis, 3 cent. longis, lanceolatis, sensim attenuato-acuminatis, basi fere 1 cent. latis, ambitu vix convexis. Infrutescentia ♀ terminalis, terna, pedunculo brevissimo, 8 mill. crasso, pedicellis tribus 3-3.5 cent. longis, biangulosis, in dorso rotundatis, in ventre planis, inermibus et glabris. Syncarpia oblonga 3.5-4 cent. longa, circiter 2 cent. diam. Baccæ numerosissimæ, 8 mill. longæ, pentagonæ, fere usque ad apicem confertæ, ibique brevissime liberæ et subpyramidato-truncatæ, vertice plano, lato, circulari, disciformi ad annulum cincto. Stigmata 4-5. Semina parva, minus quam 1 mill. longa, elliptica, utrinque acuta (sæpe abortiva).

Habitat.—Fiji Isl., Viti-levu, Colo—north, Province, Col-i-nadarivatu, edge of woods, alt. 1000 m., Nov. 15, 1927, John W. Gillespie, Plants of Fiji, 3747 ♀; and Colo-i-Suva, Parks, Pl. of Viti-Levu, 20944 ♀. (Vine 10-15 m. long, running over brush and small trees.)

Observations.—I have described the specimen 3747 to complete the description by Seemann (Fl. Vitiensis). I have no doubt about the determination of the above named specimen (3747), although I note some difference in the shape of the drupes. Specimen 20944 is in a very young state.

Freycinetia Gillespiei Mart. n. sp. a **F. Milnei** proxima

Plate 38

Caulis digiti minoris crassitudine; internodiis brevibus, 6 mill. longis. Folia apud apicem ramorum adunata, late linearia, circiter 40 cent. longa, et 25 mill. lata, apicem versus attenuato-acuminata; in parte basilaris acute plicata, canaliculata et vaginantia; lamina utrinque manifeste longitudinaliter crebre venata; marginibus basilaribus et apicalibus, brevissimo spatio, remote et brevissime denticulatis vel calloso-denticulatis; costa media, in pagina inferiore, filiformis, prominula, fere in dimidia superiore parte spinulosa; auriculis facile consumptis sed persistentibus, membranaceis, circiter 5 cent. longis, ad basim 1.5 cent. latis, ambitu convexis, sensim usque ad verticem angustatis, ibique non acuminatis nec rotundatis sed subtruncatis. Inflorescentia ♀ tantum nota terminalis, terna, cum pedicellis 3 cent. longis, 5-7 mill. crassis, in dimidia superiore parte setoso-pilosis; syncarpia cylindracea (immatura tantum vidi) 4.5 cent. longa, circiter 1.5 cent. crassa, numerosis baccis composita. Baccae immaturae prismaticae interdum prismatico-subcompressae, basi latae ibique staminodiis minutis, lanceiformibus ornatae, fere in dimidia superiore parte liberae; stigmata 5-9 interdum 4.

Habitat.—Fiji. Isl., Viti-Levu, Namosi Prov.; summit of Voma Mountain, 100 m. alt., Sept. 1927, J. W. Gillespie, Plants of Fiji; 2726 ♀.

Observations.—This resembles *Fr. Milnei* Seem., but to me it seems that it ought to be considered a distinct species, for its shorter and narrower leaves and for the auricles which are convex in outline, adhering in all their length to the blade of the leaf and becoming more attenuated as at the apex, which is not acuminate but subrotund, while in the *Fr. Milnei* (at least so it appears in the illustration in Seemann's Fl. Vitiensis) the auricles are wide, rounded, and at the apex disjoined from the blade of the leaf. I note another diverse character in the short stalks of the syncarps, glabrous in *Fr. Milnei* but furnished on the upper half with bristly hairs in *Fr. Gillespiei*. I have not seen the ripe berries of our species; they carry little staminodes at their base but I think that this characteristic has little value as the presence or not of these organs, many times, is carelessly overlooked.

***Freycinetia Parksii* Mart. n. sp.**

Plate 39

Scandens; caule 10–20 met. longo, 1 cent. crassa; folia coriacea, 60 cent. longa, lanceolata, 3.5–4 cent. lata, ad apicem attenuata, acuminata et breviter subulata, basin versus canaliculata utrinque, in sicco, tessellata, marginibus, in parte basilari et extremo apice tantum, raro et brevissime denticulatis; costa media, in pagina inferiore, acuta et fere in dimidia superiore parte spinuloso-serrata; auriculis circiter 7 cent. longis, 4–5 mill. latis, ambitu convexis, sensim ad apicem attenuato-acuminatis. Inflorescentia terminalis, quaterna, cum pedunculo valido, circiter digiti minoris crassitudine, 4 cent. longo; pedicellis 4 cent. longis, 5 mill. crassis, dorso rotundatis, antice planis, biangulosis, apice et secundum duo angulos usque fere ad medium setuloso-scabridos. Syncarpia cylindracea, 4–7 cent. longa, 2.5–3 cent. diam. Baccæ numerosissimæ, 12 mill. longæ, 3–4 mill. crassæ, prismatico-cuneatæ, basi acutæ, in quarta parte superiore liberæ, angustatæ et pyramidato-acute prismaticeæ, vertice planæ, 1.5 mill. diam. annulo subcirculari levi cincto; stigmata 5, interdum 4. Semina linearia, elliptica, 1 mill. longa, sub vitro minutissime transverse striatula, rhaphe angustissimo percursa.

Habitat.—Fiji Isl., Viti-Levu, Lami, head of Suva Harbor. Vine 10–20 m. long, climbing over low trees in swamp. Parks, Plants of Viti-Levu. May, June, July, 1927. 20045 ♀.

***Freycinetia Milnei* Seem.**

Bonpl., 1861, p. 268, nomen tantum; Fl. Vit., 1865–73, p. 283, tab. 86.

Caulis digiti minoris crassitudine, internodiis fere 1 cent. longis. Folia coriacea, in apice ramorum adunata, 60 cent. et ultra longa, 3 cent. circiter lata, sublanceolato-linearia, apicem versus sensim attenuata et breviter acuminata, basi breviter canaliculata et vaginantia, utrinque longitudinaliter crebre et conspicue venata; marginibus basis et apicis, brevissimo spatio, remota et breviter denticulatis; costa media, in pagina inferiore, filiformis et in parte apicali tantum spinuloso-denticulata; auriculis membranaceis, cito consumptis sed longe persistentibus, 7 cent. longis, et 1 cent. latis ad basim, ambitu convexis, apice late rotundatis, non liberis; pedunculus infrutescentiæ brevis, ternus (Seemann) vel quaternus! pedicellis longis, 6 cent. glabris. Syncarpia matura oblonga, 5–7. cent. longa, 2–2.5 cent. diam. numerosissimis baccis composita. Baccæ circiter 3 cent. longæ, in parte superiore breviter liberæ, angusto-prismaticeæ vix pyramidatæ, interdum subcompressæ, in reliqua parte connatæ, oblongæ, vix cuneatæ, basi latiusculæ, et staminodiis brevissimis lanciformibus instructæ; vertice stigmatifero plano, circulari vel compresso; stigmata 5 vel plura. Semina vix ultra 1 mill. longa, rhaphe et strophiole angustis cincta.

Habitat.—Fiji Isl., Viti-Levu, woods in vicinity of Nasinu, 9 miles from Suva. Prov. Naitasiri. 23 Oct., 1927, J. W. Gillespie, Pl. of Fiji, 3496 ♀.

Observations.—Since I believe that the specimen brought by Mr. Gillespie certainly belongs to this species, I have used it for the description above recorded. I observe that there are some differences (but not of great importance) between Gillespie's plant and the drawing by Seemann (Fl. Vitiensis). The auricles in our specimen are in outline convex and rounded at the apex, joined at the blade of the leaf and not free as in Seemann's plate. These auricles are membranaceous and persistent although they break and wear away readily. The berries appear to be slightly different from those of the plate (*l.c.*); that is to say, the upper free part is prismatic, narrow, sometimes compressed, plane, and circular at the apex, which carries from 5 to 9 stigmas but rarely 4. For the rest, the berries are angular and connate and one can observe two parts, the superior (that is the one directly under the free part), which is short and slightly pyramidal; the other, which corresponds to about half the berry, is rather cuneate as far as the base, which is not acute.

***Freycinetia Storckii* Seem.**

Bonpl., 1860, nomen tantum, p. 260, et in Fl. Vitien., 1865-73, p. 283, tab. 85.

Habitat.—Fiji Isl., Viti-Levu, woods in vicinity of Nasinu, 9 miles from Suva, Naitasiri Prov., at 150 m. alt., Oct., 1927. Gillespie, Pl. of Fiji, 3498 ♀ and 3497 ♀. Summit ridge trail from Somo-Soma Taviumi, alt. 750 m., Gillespie, 4819 ♀.

PANDANUS

SECTIO KEURA²**Pandanus odoratissimus** var. **pyriformis** Mart. n. v.

Plate 40

Arbor erecta, apicem versus ramosa. Syncarpium subglobosum, 20–22 cent. diam. Phalanges obpyriformes, inaequaliter pentagonae, vix compressae, 6 cent. longae, 3–3.5 cent. latae et 2.5–3 cent. crassae, lateribus levibus, subconvexis, nitidis (in sicco), acute angulosis et secundum loculis sulcis angustis, fere usque ad medium phalangis percursis, dimidia inferiore parte phalangis longiuscule angustatae, quasi caudatae (basi 10–13 mill. circiter crassae), in dimidia superiore parte liberae, leves, ambitu convexae, supra in toto subplanae; loculis plurimis, 9–11 subaequalibus, prominulis, acutis et acute angulosis, a sulcis angustis et profundis divisis. Stigma in vertice oculorum situm hippocrepiforme. Endocarpium osseum, in sectione longitudinale, 18 mill., spissum e fere medio phalangis apicem versus situm, superne rotundatum. Mesocarpium superum, valide lacunosum, medullosum; inferum fibrosum.

Habitat.—Fiji Isl., Viti-Levu, shore near Suva, Setchell, Plants of Southeastern Viti-Levu, 15668, Sept. 2, 1926, ♀.

Observations.—Awns of leaves deciduous, painful in the skin; that is, when one tries to gather the leaves, especially the younger and fairly mature ones, the small lateral awns or prickles very readily detach themselves, and if allowed to remain in the skin produce festering sores (Setchell, *in litt.*).

Pandanus odoratissimus var. **suvaensis** Mart. n. v.

Plate 41

Syncarpium erectum pedunculo valido, acute trigono, brevi suffultum, et spathis confertis ad apicem pedunculi involutum. Spathae coriaceae, lanceolato-naviculares, acutissime carinatae, 8 cent. latae, apice acutae. Si judicare possumus ab axe syncarpium, syncarpium est globoso-oblongum, fere 15 cent. Phalanges variabiles pyriformes, ambitu leviter convexo vel late cuneatae, 6–6.5 cent. longae, plus minusve compressae, 3–3.5 et etiam 4–5 cent. latae, 2.0–2.5 vel 3–5 cent. crassae, sensim usque ad basim + — attenuatae, connatae, tantummodo in dimidia inferiore parte acute-pentagonae, faciebus inaequalibus, planis, secundum loculos sulcis longitudinalibus nullis, vel uno aut duobus interdum numerosissimis, angustis e medio ad apicem phalangis percurrentibus; apice convexo-plano, loculis 5–6, interdum 12, vel numerosissimis, etiam 20, parvulis vel mediocribus, subaequalibus, rotundatis, vel pyramidatis, acutis, plus minusve acute pentagonis,

² Seemann, *Flora Vitiensis*, notes a *Pandanus odoratissimus* (Seemann, 649). The sheet in Herb. Kew consists of a single leaf without fruits, so that I am not able to judge to which variety this Seemann's *Pandanus* may be referred.

sulcis angustis divisus. Stigma ad verticem uniuicisue loculi, subhippocrepiforme, parvum vel + — crassum, prominens sicut papilla. Endocarpium osseum 2.5 cent. spissum, in medio vel in dimidia superiore parte phalangis situm; in sectione longitudinali interdum triangulare apparet, vel potius in pyramidem productum, basi et vertice pyramidis latis, interdum ambitu supra plano-subrotundatum, infra truncatum. Duo cavernae mesocarpicae, exteriores magnae et longae, centrales multo minores, omnes medullosae; mesocarpium inferum, fibrosum.

Habitat.—Fiji Isl., Viti-Levu; Suva along strand. H. E. Parks, 1927, Pl. of Viti-Levu, 20876, ♂, ♀.

SECTIO CORONATA

Pandanus vitiensis Martelli n. sp.

Plate 42

Arbor 10–15 m. alta, stipite non ramoso; (fide Parks). Folia non vidi. Syncarpium terminale, solitarium, erectum, pedunculo elongato, in sicco longitudinaliter rugoso, angustis spathis foliaceis subdistantibus vestito. Spathae decrescentes, crasse coriaceae, inferiores foliaceae, 40 cent. et ultra longae, 7 cent. latae, sublanceolato-attenuatae, acutae; spathae superiores breviores, late lanceolatae, acutae, concavo-subnaviculares, omnes utrinque crebre minute longitudinaliter venatae, basin versus leves; costa media, in pagina inferiore valida, angusta, acuta, prominens in parte basilari levis et inermis, in parte superiore creberrime et minutissime serrata; marginibus basilaribus, corneis et acute conduplicatis, inermibus, dein a denticulis creberrimis brevissimis acutis munitis in reliqua parte creberrime minutissime serratis. Syncarpium (11 × 15 cent.?) compactum latum et conicum (fide Parks) vel potius globoso-conicum, fere ex 40 drupis constant. Drupae 5.5–6 cent. longae, 3–3.5 cent. crassae, acute hexagonae, faciebus latis, subaequalibus, in parte inferiore 4.5 cent. longa inter se connatae, cuneatae, acutae, fibrosae, in parte superiori liberae inter se divaricatae, leves pyramidatae, vix rotundatae, superne truncatae, vertice plus minusve lato, disciformi suborbiculari, subconcavo, et umbilicato; stigmata plurima verticalia et applicata subito infra marginem disci coronam formantia et in disco polyradiata. Endocarpium osseum 4 cent. longum, in parte media situm et totam latitudinem drupae explens, superne truncatum, inferne vix angustatum; cavitate seminifera in medio endocarpi posita, lata, circulari. Mesocarpium superum 1 cent. spissum, dense medullosa-fibrosum, inferum 1.5 cent. fibrosum.

Habitat.—Fiji Isl., Viti-Levu at Colo-i-Suva at 300 m. alt. Parks, Pl. of Viti-levu, 1927, 20980.

Observations.—This is a magnificent and characteristic species which I hope to be able to include in my Section “Coronata,” together with *Pand. Whitmeeanus* Mart. and with *Pand. Parkinsonii* Mart. I would also like to have seen the male flowers, so as to be able to describe how they are grouped, which is at present unknown.

SECTIO LOPHOSTIGMA

Pandanus Joskei Balf.

Baker's Paper on the Fl. of Fiji, in Jour. Linn. Soc. of Lond., vol. 20, 1883-84, p. 416.

Arbor 3.5-9 m. et ultra alta, non ramosa. Folia tantum in extremitate trunci, 1.80-3.5 m. longa, 15-20 cent. lata, coriacea, acuminata, marginibus basi grosse, apice tenuiter, aculeatis. Inflorescentia mascula. . . . Syncarpium solitarium longe pedunculatum, 15-30 cent., magnum, axillare vel infrafoliaceum conoideum vel ovoideum, 15-30 cent. longum, 10-25 cent. latum. Spathae plurimae, ovato triangulares, ovatae, acuminatae, 18 cent. longae, 7 cent. latae. Drupae monoloculares 6-8.5 cent. longae, 12-20 mill. latae, sensim obcuneato-attenuatae, basi acutae, longe acute-pentahexagonae, latis planis, apice truncatae, planae. Stigma centrale, lato 6 mill., nitidum, adpressum, cristatolobatum. Endocarpium osseum vix infra medium drupae positum, spissum 3 cent., supra conico-acutum inferne longe obcuneatum utrinque fibris robustiusculis cinctum.

Habitat.—Fiji Isl., Viti-levu; common between the Wai Manu and the Reiva River on alluvial land; also in damp spots near streams in the mountains at the sources of the Tamarina River, between Suva and the Reiva River (cf. Balf.); Fiji Isl., legit. Mr. Jeoward in Kew Museum. Mount Korobamba, May-July, 1927. H. E. Parks, 20344.

Observations.—Tree 10-30 feet high, unbranching; leaves long. Cones developed below leafy crown (Parks).

Pandanus levuensis Mart. n. sp.

Plates 43 and 44

Arbor parva, 3 m. alta, pluriramosa. Syncarpium solitarium, erectum cum pedunculo ultra 40 cent. longo, plurimis spathis subdistantibus, foliaceis, coriaceis, omnino induto suffultum. Pedunculum 1.5-2 cent. crassum trigonum, creberrime sagrinatum et longitudinaliter valide et crebre rugosum. Spathae decrescentes, inferiores verisimiliter foliis simillimae, coriaceae, ultra 0.5 m. longae, lineari-lanceolatae, attenuatae, acutae, 7 cent. circiter, latae, ima basi subdecurrentes et pedunculum cum parte inferiore involventes, profunde at acute canaliculatae, dorso acutissimo, in pagina inferiore leves, basin versus crebre punctulato-sagrinatae; parti apicali laminae subexplanata, utrinque venatae; marginibus in parte basilari conduplicatis, crebre et acute denticulatis, dentibus irregularibus, rectis, acutis in parte intermedia, brevi spatio, inermibus, in reliqua parte, minute et creberrime serratis; dentibus rectis; costa media acuta prominente in dimidia superiore parte tantum irregulariter crebre, brevissime denticulato-serrata. Spathae superiores plurimae, confertae, syncarpium paullum superantes, interiores breviores sublineari lanceolatae, omnes, involucrantes, coriaceae, spathis foliaceis simillimae, late-

lanceolatae, acutae, concavo-convexae, dorso acutissimo quasi carinato et marginibus, parte basilari excepta, dense, validiuscule et brevissime denticulato-serratis. Syncarpium erectum, solitarium, 7.5–11 cent. longum, 6–10 cent. diam. oblongum, numerosis phalangibus instructum. Phalanges compactae, variabiles, maturae circiter 28 mill. longae, 14–20 mill. circiter latae, acute-penta hexagonae, lateribus subaequalibus e medio ad basim connatae et attenuato-cuneatae vel contractae, e medio ad apicem liberae, pyramidatae vel convexo-pyramidatae, truncatae, lateribus longitudinaliter breviter costulatis, vertice lato-truncato-plano, disciforme, ambitu irregulariter rotundato vel subconcavo. Stigmata plurima coronam formantia subito infra marginem disci, verticaliter disposita et in disco plus minusve irregulariter radiatis, radiis linearibus; in sectione longitudinali endocarpium osseum in medio phalangis situm, 12 mill. spissum, totam latitudinem occupans, utrinque truncatum vel superne vix convexum et ad centrum in mucronem brevissimum productum; locus semifer unus, magnus; mesocarpium inferum et superum fibrosum. Phalanges immaturae quas tantum vidi, prismatae 3 cent. longae 1.5–2 cent. latae vel cuneatae, apicem versus convexae vel convexo brevissime pyramidatae, latissime truncatae in dimidia superiore parte liberae, inferiore connatae, vertice lato plano; stigmata illis phalangibus jam descriptis simillima. In sectione longitudinali endocarpium incompletum apparet, angustum et in medio dimidia partis inferioris situm; locus semifer unicus basilaris; mesocarpium crasse fibrosum endocarpium involvens. Cetera ut in phalangibus maturis.

Habitat.—Fiji Isl., Viti-Levu, Mt. Korobamba, H. E. Parks, 1927, Pl. of Viti-Levu, 20345 ♀; vicinity of Nasinu, 9 miles from Suva, Naitasiri Prov., in woods, alt. 150 m., Oct., 1927, Gillespie, Pl. of Fiji, 3443.1 ♀.

SECTIO ACROSTIGMA

Pandanus Thurstonii Wright

Decades Kew, Decas. IX in R. Gard., Kew, Bull. of Miscell. Inform., 1894, p. 349.—*P. caricosus* Seem. (non Rumph.) Fl. Vit. p. 281.

Fruticosus, foliis linearibus acuminatis, marginibus minute denticulatis; costis integris; druparum capitibus circa 8, racemose dispositis; drupis sejunctis 5–6 angulatis; stigmatibus spinosis secedentibus; semine solitario (Ex Wright, l.c.).

Habitat.—Fiji (Thurston), the spadix collected by Mr. Geovard.

Observations.—In the Kew Herb. there is a leaf which is 12 cent. broad without thorns on the margins at the base, and very small in the remaining portions. The spadix is composed of 9–10 syncarps, each one is 13 cm. in length and 8 cm. broad. The species does not belong to the *Sectio Rykia* but to *Acrostigma*. In the collection of Parks and Setchell, the species is not represented.

PLATE 37

***Freycinetia Graeffi* Martelli**

Parks, 20083



PLATE 38

***Freyinetia Gillespiei* Martelli**

Gillespie, 2726



PLATE 39

Freycinetia Parksii Martelli

Parks, 20045



PLATE 40

Pandanus odoratissimus var. *pyriformis* Martelli

Setchell, 15668



PLATE 41

Pandanus odoratissimus var. *suvaensis* Martelli

Parks, 20876

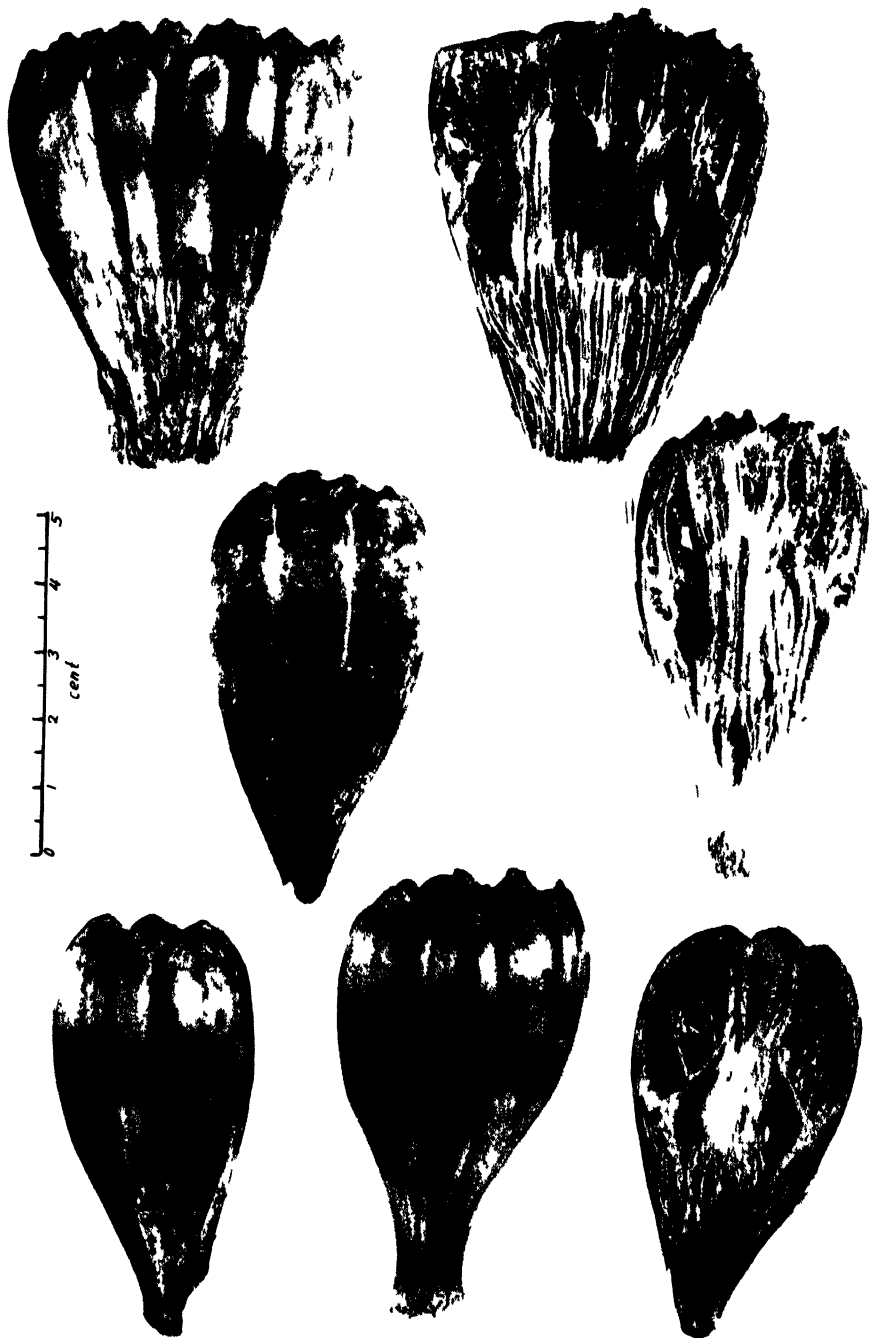


PLATE 42

***Pandanus vitiensis* Martelli**

Parks, 20980

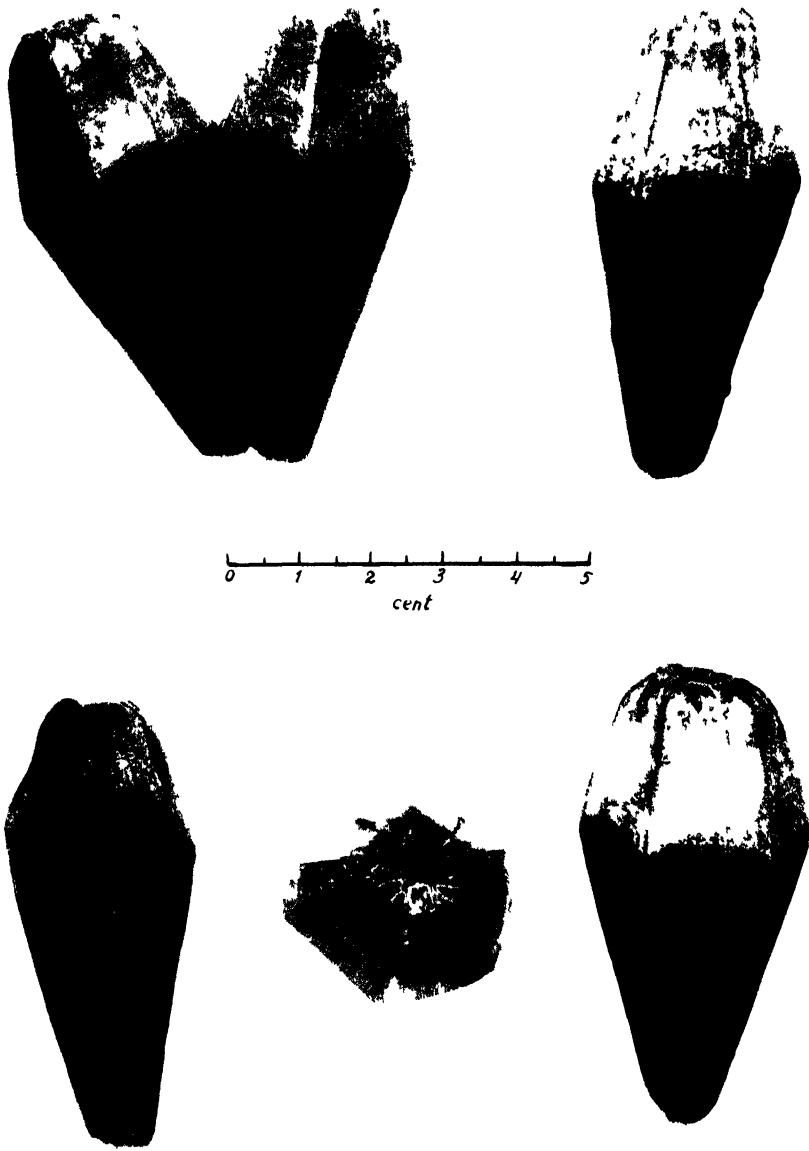


PLATE 43

Pandanus levuensis Martelli

Gillespie, 3443.1

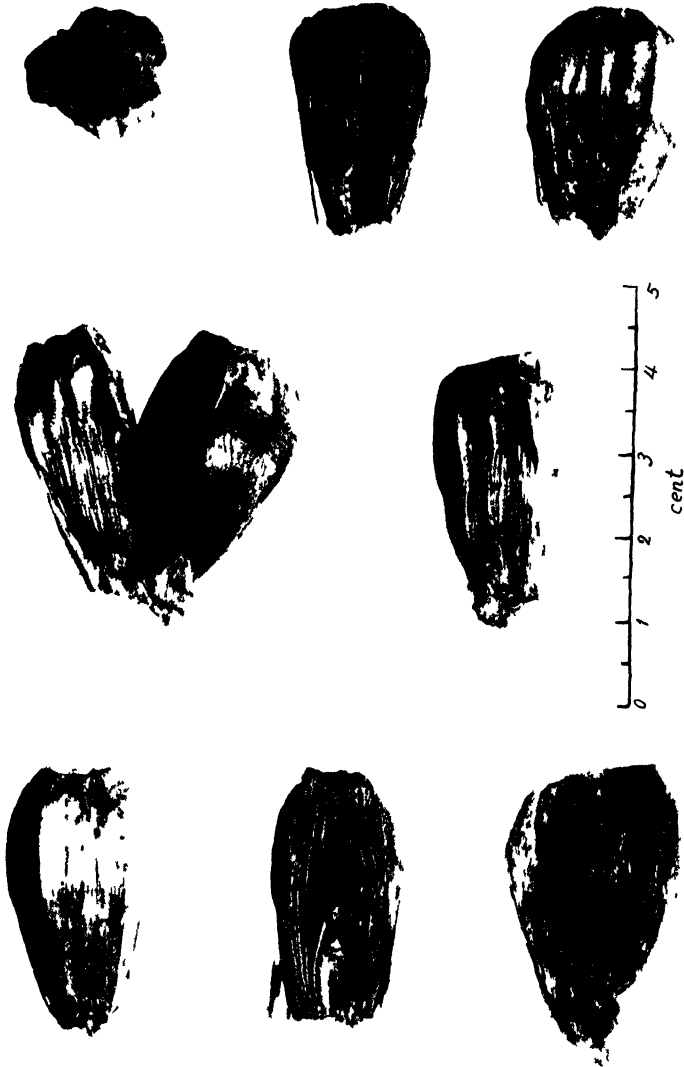
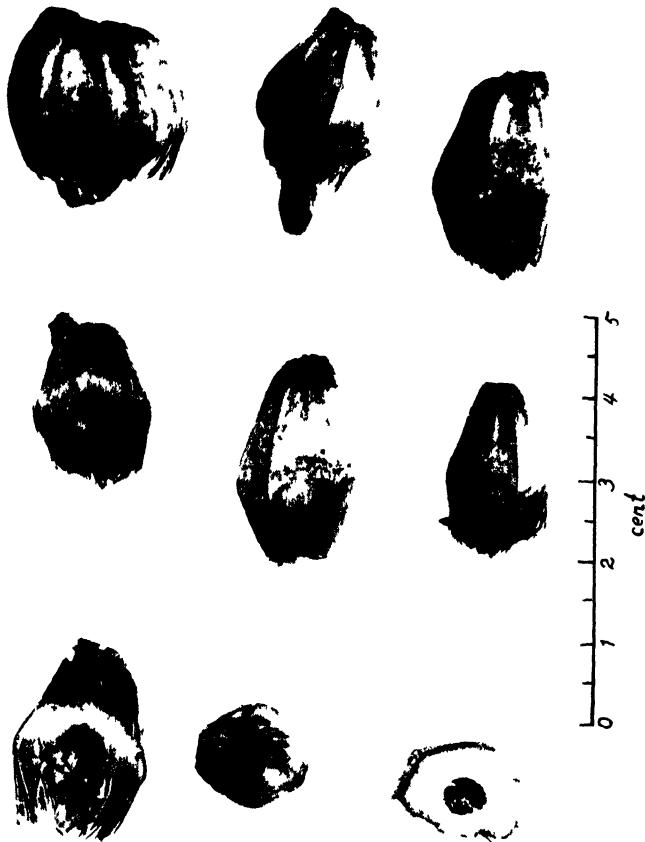


PLATE 44

Pandanus levuensis Martelli

Parks, 20345



PANDANACEAE OF TONGA

BY

UGLINO MARTELLI

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PANDANACEAE OF TONGA

BY

UGLINO MARTELLI

The flora of the three groups of islands which form the Archipelago of Tonga, or Friendly Isles, has been explored many times by various botanists and travelers¹ and has been the subject of some publications; so much so that it can be considered one of the best known floras of these regions. I must observe, however, that in these interesting botanical studies the family of the Pandanaceae has been treated somewhat summarily. Hemsley, for example, in the Flora of the Tonga or Friendly Isles (Jour. Linn. Soc., vol. 30, pp. 158-216) and Burkill, in Flora of Vavau (Jour. Linn. Soc., vol. 35), mention only the *Pandanus odoratissimus* Linn. and do not even cite the peculiar and most interesting *Freycinetia Urvilleana* Hombr. described in 1843 in Dumont d'Urville, Voy. au Pole Sud et Oceanie de l'Astrolabe et la Zelée, 1837-40, tab. 3. Professor Warburg in Engler, Pflanzenr., Pandanaceae (1900), in the chapter "Übersicht über die Verbreitung der Sect. der Gattung Pandanus," p. 92, and in the article "Central Polinesien," indicates the *Pandanus tectorius* (= *P. odoratissimus* Linn.) as existing in Tonga, but I have not succeeded in discovering the locality among those mentioned at the end of the descriptions of this species or of its varieties (Warb., *l.c.*, p. 48); so I do not know to which variety the author meant to assign the plants of Tonga.

The collection of Pandanaceae gathered at Tonga in 1927 by W. A. and C. B. Setchell and H. E. Parks, and sent to me by Dr. E. D. Merrill, is composed of eight different forms of *Pandanus* and a *Freycinetia*, the *F. Urvilleana* Hombr. In the floras of the Tonga by Hemsley and by Burkill (which are the most recent works), only one *Pandanus*, the *odoratissimus* Linn., figures. The much larger number of species and varieties here cited will therefore come as a great surprise, and spontaneously the question arises, how to explain why so many different species or varieties escaped the researches of previous botanists; and so much more so, since we are dealing with quite visible

¹ Cook, Wilkes, Mosely, Gazelle Expedition, Graeffe, Lister, Horne, Burkill and Crosby, Forster, etc.

arboreal plants. It is true that only two are to be considered as species and the others as varieties of the *Pandanus odoratissimus* Linn. One might make the hypothesis that these species in the period of former herborizations did not grow on the archipelago and that their presence there today is through recent introductions. Such an explanation, according to my idea, might account, perhaps, for the presence of two of the species and three of the varieties, as I will point out later, but I do not think it explains the remainder. The very clear and precise notes that were sent with each specimen gathered in 1927 leave an opening, with five of the species (varieties included), for the possibility of introduction, but such a supposition gives no explanation of the presence of the others. If these species and varieties have been recently introduced, it is certainly owing to man, and because of their utility; and if this was of an industrial nature, one ought to find the species very widespread or at least in extensive areas. If, on the other hand, the introduction came about through curiosity, or for purposes of ornament, or some other reason, then the plants would be very circumscribed, the individual specimens would be rare and would be found only near native habitations—I might almost say, in cultivated patches. In either case the actual collector would have realized and noted the fact, as was done in the case of three or five specimens. Even admitting that the presence of these species in the Tonga Archipelago is owing to their introduction, then very probably they were imported from the near archipelagoes, such as those of Fiji, Samoa, Cook, etc., with which the inhabitants of Tonga have their greatest exchange of trade. In those places, therefore, these plants ought to be in existence, and be known and valued for their utility, so, I think, the logical conclusion would be that these species or varieties should already have been described in the floras of those archipelagoes. One cannot believe that only rare and useless species were preferred for importation.

I have given above only an hypothesis on the introduction into the archipelago of the Friendly Isles of two species and three varieties of *Pandanus*, among the eight now collected, which might be admitted because the notes of the actual collector give an admissible reason. These are the species:

1. *Pandanus corallinus* n. sp.

15420. Professor W. A. Setchell gathered the specimen and wrote to me that he had not seen either the plant or the fruit, but only some phalanges, worn around a woman's neck as a necklace, at Mua, the

old capital of Tongatabu. With the help of an interpreter, he found out only that these phalanges had probably been collected in Tongatabu or in Eua, more likely the former. The woman, as a great favor, gave him some of the phalanges. This might lead us to suppose that the plant might be of foreign origin and may now be cultivated near some native habitations in Tongatabu or in Eua, possibly because of its desirability for amulets or ornaments or because of the pretty coral color of the phalanges. It might also be that the phalanges, already strung as necklaces, are imported from who knows where? perhaps from Fiji? to Tonga or Eua. According to Professor Setchell, these necklaces appear to have some story attached to them, but he has never been able to discover it. It is often very difficult to obtain information from the natives, who are very reticent.

2. ***Pandanus odoratissimus* Linn. var. *pseudo-Linnaei* n. var.**

15359. The specimen which I have named as above, is accompanied by a note that tells us it grows near habitations, also that it can be supposed to be under cultivation and thus to represent an introduced plant.

3. ***Pandanus odoratissimus* Linn. var. *pyriformis* Mart.**

Plate 45, figures 6 and 7

15644. This specimen was also collected in Viti-Levu by Setchell, Pl. Viti-Levu. Has this variety been introduced into Tonga from Fiji? And are the phalanges, turning red, used as amulets, as are those of *P. corallinus*?

4. ***Pandanus odoratissimus* Linn. var. *savajensis* Mart. forma major**

15292. This plant was gathered from the Powell Plantation, at 500 m. above sea level, which makes us think that it may be an imported plant, perhaps from Samoa (where it is grown) for its utility, for shade, for shelter from the wind, or for other reasons. The specimens of this variety seem to have kept their typical characteristics in Tonga, the only variation being in the size of the phalanges, as might easily happen.

5. ***Pandanus odoratissimus* Linn. var. *sinensis* (Warb.) Mart.**

15651. The presence of this in Tonga, I am sure, is owing to introduction by Chinese; the extensive appearance of the species in various separate Australasian localities shows this clearly.

These are the five species and varieties which, among those actually found in Tonga, I could (always with reservation) admit have been recently introduced, but the other three (two varieties and one species) are as yet unexplained, for the reason that previous botanists have not noted them. Perhaps, little familiar with the forms of the *Pandanus*, which have a general similarity of appearance, they were convinced that only one species of the plant is found on the archipelago and neglected to make further observations. Certainly this is a strange thing for expert collectors to do, but is it less strange that the clearest illustrators of this flora omit to mention the *Freycinetia Urvilleana* Homb.? Since I have indicated this most interesting *Freycinetia*, I would invite some collector to make researches on the plant (Fl. Rarotonga, in Trans. Linn. Soc., Lond., 1903) that Mr. T. F. Cheeseman saw in abundance (but not in flower or fruit), scrambling up trunks of trees or covering the rocks on the highest part of the Island of Rarotonga (Cooks Archipelago), with the object of ascertaining whether it is the same as the *F. Urvilleana* Homb. of Vavau (Tonga) or a form of it. I maintain with almost absolute certainty that the Rarotonga species is separate and peculiar to those islands, like all other Australasian *Freycinetias*. If indeed it could be established or certified as being an identical species with one of the others of the Australian *Freycinetias*, it would be a new fact and not lacking in importance, since it would assist us to arrive at correct conclusions, more especially in the study of geographical distribution of the *Freycinetia* in those regions. I hope this dissertation will find a response in some willing and intelligent person who lives in Rarotonga.

FREYCINETIA

Freycinetia Urvilleana Homb.

Dumont d'Urville, Voy. Astrol. et Zélée, Atlas (1852), tab. 2; and *idem* in Decaisne, Monocotyl (1853), p. 83 (descrip. tab.).

Scandens; caulis etiam 30 m. elongatus; apicem versus digiti crassitudine, ibique foliosus internodiis brevissimis. Folia approximata, imbricata, coriacea, 50–60 cent. longa, 3–5 cent. lata, in planta ♂ angustiora, vix lanceolata, basi dilatata, apicem versus attenuato-acuminata et subulata; auriculis 7–8 cent. longis, circiter 5–7 mill. latis (ad basim), submembranaceis, integris, ambitu subconvexo, sursum longissime attenuato-acutis et adnatis; lamina foliae utrinque longitudinaliter manifeste venata; in pagina inferiore, præcipue basin versus, sparse transverse tessellata; costa media filiformi, in parte basilari evanida, apicem versus tantum denticulato-serrata; margini-

bus laminae inermibus vel in parte apicali tantum denticulatis. Inflorescentia ♂ terminalis, terna, pedicellis robustis 6 cent. longis, 5 mill. crassis, glabris; parte staminifera 5 cent. longa; stamina non vidi. Syncarpia terna, pedicellis ut in planta ♂, cylindracea, parte fructifera 9–10 cent. longa, 2.5 cent. diam. Baccæ numerosissimæ, confertæ, inter se liberae, elongatae, acute angulosae, maturas non vidi, parte apicali brevi vix pyramidato truncata, reliqua parte multo longiora, usque ad basin sensim attenuata, ibique staminodiis elongatis instructa. Stigmata 5, vel numerosa (etiam 10) semina immatura, multo elongata, subulata.

Habitat.—Eua Island, Tonga. Vine climbing the tallest trees. H. E. Parks, June, 1926. Pl. of Eua Isl. 16279, ♂ ♀.

Observations.—I have no doubt about the determination of this specimen as *Freycinetia Urvilleana* Hombr. although for description we have only that made by Professor Warburg² (Monogr., p. 38) from the cited plate. I have preferred to describe the species anew from our specimen. We observe in our plant that the leaves are larger, although in the male plant they are smaller than in the female one. The syncarps in our specimen are cylindrical and not elliptical as the plant shows. We observe also some other differences of shape in the staminoids and berries. The number of the stigmas varies from 5 to 10.

PANDANUS

SECTIO KEURA FORSK.

Phalanges. Stigmata sessilia, obliqua vel erecta. Loculi circuli in modo vel irregulariter dispositi. Stamina in columna vel fasciculata, vel racemosa.

Pandanus odoratissimus Linn. f.

Frutex caespitosus vel arboreus 3–6 m. altus, pluriramosus. Folia plus-minusve elongata, linearia, longe acuminato-caudata, 4–5 cent. lata, marginibus et carina armatis (in varietate *leve* Warb. inermibus).

² Decaisne, in Dumont d'Urville, Voyage au Pole sud de l'Astrolabe et de la Zélée, Monocotyledons, p. 83, gives only the explanation of this species: "Tab. 2.—*Freycinetia Urvilleana* Hombr. Fig. 1.—Fructus ab inflorescentia segregatus et natura paulo maior.—Fig. 2. Idem valde auctus, basi staminibus abortivis stipatus.—Fig. 3. Idem transversim rejectus.—Fig. 4. Idem longitrorsum fissus et acte explicatus ad parte faciendâ placentaria et ovula.—Fig. 5. Placentariorum pars minuta ovulifera.—Fig. 6. Stigmata a fronte visa.—Fig. 7. Stamina abortiva.—Fig. 8. Frustulum folii parte superiore marginibus involutis dissectum." On page 9 of the same volume Decaisne says: "Quant aux lacunes qui existent dans le texte que je donne ici, elles tiennent à ce que je n'ai pas pu retrouver, dans l'herbier de Mr. Hombron, toutes les plantes qu'il a fait dessiner dans son Atlas. Cet herbier ayant passé par plusieurs mains, il est arrivé, comme d'habitude, que quelques plantes ont été perdues ou égarées. Ne pouvant faire leur description d'après nature, et ne me fiant pas suffisamment à l'exactitude des planches, j'ai dû me borner à des courtes phrases descriptives, à une simple explication des figures etc."

Inflorescentia mascula 50–100 cent. longa, pendula, composita, spadicebus numerosis propria bractea suffultis; spathis odorantissimis navicularibus foliis brevioribus, in parte sub-basilaribus albidis, in apicale virescentibus foliis simillimis. Stamina alba, fasciculata in columna (rhachide) disposita; antherae lineares, elongatae, mucronatae. Syncarpium solitarium plurimis spathis confertis indutum variabile, persaepe magnitudinis capitis, globoso-ovatum, drupis $\pm$ numerosis in phalangibus turbinatis connatis constitutum. Drupae connatae sed ad breviter liberae convexae vel rotundatae a sulcis $\pm$ profundis interdum superficialibus separatae.

Pandanus odoratissimus Linn. f. var. **savaiensis** forma **major** Martelli

Plate 45, figures 3–5

P. tectorius var. *savajensis* Martelli (forma *major*) in Reehinger Bot. et Zool. einer wissenschaft Forsch. nach. Samoainsl. Neuguin, Archip. und Solomon, 1910, p. 38.

Phalanges fuscae, 5 cent. longae, 3–4.5 cent. latae, interdum subcompressae 23–27 mill. crassae, tetra-pentagonae, irregulariter prismaticae faciebus latis planis plus quam in dimidium inferiorem partem attenuato-obpyramidatae, ibique connatae, in apice truncatae, planae, loculis 6–10, brevibus, rotundato-pyramidatis, sulcis brevibus, conspicuis, separatis. Endocarpium osseum circiter 2 cent. spissum, superne convexiusculum; mesocarpium superum 12 mill. cum cavernis ampliusculis, fibroso-medullois; inferum 1 cent. longum, cum fibris crassis numerosis.

Habitat.—Eua Isl., Tonga. On Powell plantation at 150 meters altitude. Parks, Pl. of Eua Isl., 1926. June–July. 16292.

Pandanus odoratissimus Linn. f. var. **Parksii** Martelli n. var.

Plate 45, figures 1 and 2

Arbor circiter 3.25–4 m. alta, ramosa. Syncarpium circiter 30 cent. long. et 20–22 cent. diam., subglobosum (fide Setchell et Parks) pedunculo 20 cent. longo, 2 cent. crasso, erecto suffultum. Phalanges circiter 35; cuneatae plus quam in dimidium inferiorem partem connatae, 3.5 cent. circiter longae in apice 4.5–5 cent. latae, subcompressae, 3 cent. crassae, pentahexagonae, faciebus latis, subplanis, secundum loculos leviter sulcatis, basi 1.5–2 cent. lata, in apice, ambitu, subconvexo; loculis numerosis (12–18), mediocribus, subaequalibus, brevibus rotundato-angulosis; vertice a stigmate brevi, prominenti, erecto elato. Endocarpium osseum totam latitudinem phalangis, parte mediana, explens in sectione longitudinali inferne subplanum, fere concavum, superne convexum fere 2 cent. spissum. Mesocarpium superum 1.5 cent. longum cum cavernis oblongis, fere latis, medullosa-fibrosis; inferum 1 cent. spissum fibrosum.

Indigenous name.—“Fa Hina.”

Habitat.—Tonga; Tongatabu Isl., at Houma, forming outer tree belt. May, 1926. Setchell and Parks, Pl. of Tongatubu. 15198.

***Pandanus odoratissimus* Linn. f. var. *pseudo-Linnaei* Martelli n. var.**

Arbor magna, ramosa. Folia elongata. Syncarpium . . . ad maturitatem flavum. Phalanges 7 cent. longae, 4.5–5 cent. latae, incerte tetra-pentagonae, subcompressae, 3–3.5 cent. crassae, fere in dimidiam superiorem partem liberae, ibique ambitu prismaticae et longitudinaliter secundum loculos numerosis, angustos et elongato-prismaticos, sulcis angulosis in dimidiam inferiorem partem connatae, et sensim, usque ad basim 2.5 cent. latam, leviter attenuatae; supra, in lato planae, loculis 7–10, digitis minoris circiter crassitudine apice acute pyramidato-subrotundatis, angulosis multo elevatis; vertice loculorum exteriorum tantum in disco anguloso latiusculo explanato. Stigma hippocrepiforme apicali, sed a latere situm subverticale. Endocarpium osseum, in sectione longitudinali, totam latitudinem phalangis explens utrinque ambitu truncatum, 3 cent., spissum; mesocarpium superum 2 cent. spissum cum cavernis latis, oblongis, medulloso-fibrillois; inferum 1.5 cent. spissum, fibrosum.

Indigenous name—"Fa Hina."

Habitat.—Tonga, Tongatabu Isl. Vahe Ha'ake, near houses; Setchell et Parks, Pl. of Tongatabu, June 21, 1926. 15359.

Observations.—The phalanges have some similarity to those of *Pand. Linnaei* Gaud., but they are not turbinate like the latter; the base is wide and the sides free and prismatic. The vertices of the most external locules are spread out, the stigmas are excentric, always at the apex, and always lateral and vertical.

***Pandanus odoratissimus* Linn. f. var. *Setchellii* Martelli n. var.**

Arbor ramosa, "12–20 ft." alta. Syncarpium subglobosum, circiter 15 cent. diam., pedunculo erecto, circiter 20 cent. longo, et 2 cent. crasso suffultum. Phalanges numerosae, maturae flavae, 5 cent. longae, leviter subturbinatae, et sensim cuneatae in apicem 3.5–4.5 cent. ad basim 2–2.5 cent. latae, irregulariter acute penta-hexagonae, faciebus subplanis, latis, levibus. Supra, in toto, truncatae, planae, loculis 9–12 profundissime et angustiuscule separatis exterius paullo majoribus, in corona dispositis; erectis in acutam pyramidem angulosam. Stigma hippocrepicum verticem explens. Endocarpium osseum (in sectione longitudinali) ambitu prismaticum utrinque truncatum, totam latitudinem phalangis occupans, circiter 2 cent. spissum. Mesocarpium superum 1.5–2 cent. spissum, cum cavernis oblongis, latis, medulloso-fibrillois; mesocarpium inferum 1.5 cent. compactum fibrosum.

Indigenous name.—"Higano" ♂ and "Fa Hina" ♀.

Habitat.—Tonga, Tongatabu Isl. Belt of trees at Hufagalupe. June 28, 1926. Setchell et Parks, Pl. of Tongatabu, no. 15441 ♀, no. 15437 ♂.

Pandanus odoratissimus Linn. f. var. **pyriformis** Martelli n. var.

Plate 45, figures 6 and 7

Syncarpium mediocre; globosum, 12 cent. diam., pedunculo 1 cent. crasso, 12 (?) cent. longo, erecto suffultum. Phalanges pyriformes, apice 2.5–3 cent. diam. ad basim (7 mill. lata) attenuato-caudatae, acute penta-hexagonae, faciebus levibus, subplanis vel longitudinaliter leviter undulato-sulculatis, supra ambitu subplanae, loculis fere aequalibus, parvis et brevibus, rotundatis, sulcis angustis, conspicuis divisis. Stigma hippocrepiforme, parvum, prominens, papilliforme, subhorizontale, in vertice loculorum situm. Endocarpium osseum fere 2.5 cent. spissum, pyriforme, supra rotundatum; mesocarpium superum circiter 1 cent. cum cavernis parvis, fibrosis, laxe medullosis, inferum compactum 12 mm. longum.

Indigenous name.—"Fa Vula."

Habitat.—Tonga, at Nukualofa (the principal town or village on the island and the capital of the kingdom), Tongatabu Isl.; Setchell et Parks, Pl. of Tongatabu. Aug., 1926. 15644.

Observations.—I think it is the same Viti-Levu (Fiji) species that I have already described in my "Fiji Pandanaceae." Is it an imported species? The phalanges of the Tonga species are somewhat smaller than those of the Fiji species. I wish to give a description also of the Tonga phalanges so as to be able to indicate the differences between them and those of Viti-Levu.³

Pandanus odoratissimus Linn. f. var. **sinensis**

P. tectorius var. *sinensis* Warb. in Engl. Pflanzenr. Pandanaceae, 1900, p. 48.

Habitat.—Vavau Island (Tonga), Setchell, Plants of Vavau. 15651.

Indigenous name.—"Fa hola."

Observations.—It is a small tree and I think that this variety was probably introduced by the Chinese.

³ On the label is written: "The collector was Willie Sääfings, half-Samoan, half-German. I suspect that the native name 'Fa Vula' is applied to several species where phalanges are deep red." (Setchell in litt.)

SECTIO CORONATA MART.

Phalanges. Stigmata elliptica linearia coronam subito infra marginem disci formantia, interdum etiam super in disco in lineas polyradiatas producta.

Pandanus Whitmeeanus Mart.

Plate 45, figures 8 and 9

Webbia, I, p. 364, and IV, tav. 22, fig. 4.

Habitat.—Tonga, Tongatabu Isl., 15650, Setchell et Parks.

Indigenous name.—"Paogo."

Observations.—The leaves are used for making fine mats. The specimen was brought in and named by Bouli, a Tongan chief (Setch. et Parks). I described the species on a specimen collected at Samoa. This species I described many years ago, but only studied the phalanges sent to Kew herbarium by the missionary, the Rev. Whitmee. Is it a species imported to Tonga especially for making fine mattings? Is it an indigenous species to Samoa, or does it also grow on that island in consequence of importation? Could it not better be a Fijian species, where I believe the "Coronata section" type has its center of formation?

[See also, Setchell, Veg. Tutuila Island, Carnegie Inst. Wash., Pub. 341, p. 117, 1924. Editors.]

Pandanus corallinus Martelli n. sp.

Plate 45, figures 10-12

Syn carpium. . . . Phalanges oblongae, prismaticae, compressae, ambitu-falcatae, dorso convexae acute penta-hexagonae, 4.5 cent. longae, 1.5-2.5 circiter cent. latae, 13-15 mill. crassae inter se liberae? corallinae, ad apicem umbratiae vertice corrugato, lato, explanato obliquo. Stigmata plurima (4-6) plana adpressa, latiuscula ellipsoidea, nigrescentia, infra marginem circum discum apicalem disposita. Endocarpium osseum infra medium locatum compactum, 1.5 cent. spissum, in sectione longitudinali ambitu rotundatum, superne truncatum, totam amplitudinem phalangis occupans. Mesocarpium superum medullosum, elongatum, circiter 2.5 cent.; inferum brevissimum 5 mill. spissum.

Indigenous name.—"Fa Kula."⁴

Habitat.—Tonga; Plants of Tongatabu Island, collected by Setchell and Parks. June, 1926. 15420.

Observations.—The phalanges (coral red) are worn as women's necklaces (see pp. 352 and 353).

⁴ Professor Setchell suspects that the native name "Fa Kula" is applied to different species whose phalanges are deep red.

PLATE 45

Figs. 1, 2. *Pandanus odoratissimus* var. *Parksii* Mart.

Figs. 3-5. *Pandanus odoratissimus* var. *savajensis* forma *major* Mart.

Figs. 6, 7. *Pandanus odoratissimus* var. *pyriformis* Mart.

Figs. 8, 9. *Pandanus Whitmeeanus* Mart.

Figs. 10-12. *Pandanus corallinus* Mart.

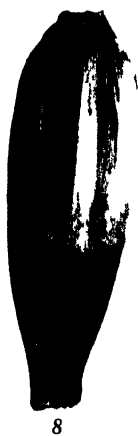


PLATE 46

Figs. 1-3. *Pandanus odoratissimus* var. *pseudo Linnaei* Mart.

Figs. 4-6. *Pandanus odoratissimus* var. *sinensis* (Warb.) Mart.

Figs. 7-9. *Pandanus odoratissimus* var. *Setchellii* Mart.



1



2



4



3



7



5



8



6



9

**TWO NEW VARIETIES OF PANDANUS
ODORATISSIMUS LINN. IN THE
HAWAIIAN GROUP**

**BY
UGLINO MARTELLI**

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TWO NEW VARIETIES OF PANDANUS ODORATISSIMUS LINN. IN THE HAWAIIAN GROUP

BY

UGLINO MARTELLI

The Pandanaceae of the Hawaiian Islands are still in need of particular study. One knows about them at present only as much as when Mr. Gaudichaud published his work, *Voyage de la Bonite autour du Mond*, 1836-37. Of the genus *Freycinetia*, we know of only one species which lives in the Hawaiian Islands. That is *Freycinetia arborea* Gaud. (= *F. Arnotti* Gaud.)¹ and it extends upward to an altitude of 1400 m. and descends in some places even to the seacoast. This one is endemic and is not to be found elsewhere.

According to Hillebrand's *Flora* (1888), there exists only one *Pandanus*, the *P. odoratissimus* L. f. This author does not take heed of the subspecies or varieties, and gathers under that unique typical name those also that Gaudichaud collected during his stay at Hawaii and distinguished as separate species:² *P. Douglasii*, *Chamissonii*,

¹ In Mann, Horace, *Flora of the Hawaiian Islands*, Proc. Am. Acad. Arts and Sci., vol. 7, p. 204, 1866, is written: "*Freycinetia arborea* Gaud., Bot. Freyc. Voy., p. 431, tab. 41. *Fr. scandens* Hook. et Arn., Bot. Beech. Voy., p. 97, non Gaud.—There is only one *Freycinetia* known in the Hawaiian Islands, and this is well figured and described by Gaudichaud, the founder of the genus, under the name of *F. arborea*. It is, however, never known to grow upright, but climbs over and among trees, making a dense tangle, and is expressively named by the natives I-e ie, meaning 'to step over.' Possibly Gaudichaud may have been misled by plants growing over the *Dracaena aurea*, and may have mistaken the two plants for one, the leaves being somewhat similar; but his specific name, however ill-chosen, could not now well be superseded. Hooker and Arnott, having scantend specimens destitute of flower and fruit, unfortunately referred them to *F. scandens* Gaud. l.c. of Mollucca and Timor, a species with a single small stigma and in other respects totally different from the Hawaiian one, which has a clavate ovary with a truncate apex bearing 5-7 stigmas. This has created a confusion in all subsequent works, which even Kurtz, with Gaudichaud's figures before him, has failed to clear up in his recent monograph of the genus (Seem. Jour. Bot., vol. 5, p. 133). So far from the species 'not existing in nature,' it is one of the two species upon which Gaudichaud founded the genus, and differs from *Fr. scandens* (M. et B.)."

² Gaudichaud, during the journey with La Bonite, visited two islands of the Hawaiian Archipelago: Hawaii or Awhyhee, and Oahu or Woahoo islands; in the first one he stopped at Karakokoa Bay and at Kairua Bay (west coast); on the second one, at Honolulu (cf. Vaillant, *Voy. autour du Monde sur la Corvette La Bonite*, "Geologie et Mineralogie," par Chevalier; or *idem*, *Relation du Voyage*, vol. 2; or Pascallet, *Notes bibliographiques de M. Gaudichaud* (Paris, 1844).

Menziesii,³ whose specimens (some phalanges only) are kept in the carpological collections of the Museum at Paris.

Professor Warburg, in his Monograph, recognizes among the Hawaiian forms of *Pandanus odoratissimus* L. (= *P. tectorius*), one more new variety which he calls var. *sandvicensis* Warb. I am of the opinion that this variety is not at all different from his other one, the var. *sinensis* Warb. (pl. 46, fig. 2).

I do not agree with the opinion of holding forms or varieties under the typical name only; I prefer to note them separately for each country.⁴ I therefore keep separate, one from the other, the three varieties admitted and illustrated by Gaudichaud, *op. cit.*, and the var. *sinensis* Warb. (= var. *sandvicensis* Warb.). I add to them two more, that, I think, have not yet been noted. For the two new varieties here described, I am indebted to the kindness of Dr. E. D. Merrill, who gave the specimens to me, and I very gratefully thank him.

It is very likely that in the Hawaiian Islands other undescribed species or subspecies or varieties are to be found, and I hope that research leading to their discovery may be conducted by the Bishop Museum at Honolulu. The few varieties of *Pandanus* of Hawaii that I know, seem to be impressed by a common local stamp, such as I have observed in similar cases for species of different centers of origin. In consequence these varieties must be, I think, very ancient or rather, aboriginal.

³ The *P. Menziesii* seems to me to be very like *P. Rumphii* Gaud., Bonite, tab. 22, fig. 11, which was collected in the Moluccas (carpol. coll. of Paris) but the locality is not more definitely designated.

⁴ Martelli: "*Pandanus odoratissimus* or *Pandanus tectorius*?" Nuovo Giorn. Bot. ital., 1929.

PANDANACEAE FROM THE HAWAIIAN ISLANDS KNOWN UP TO THE
PRESENT TIME

Freycinetia arborea Gaud.

Pandanus odoratissimus Linn. f.

var. *Chamissonii* (Gaud.) Mart.

var. *Menziesii* (Gaud.) Mart.

var. *Douglasii* (Gaud.) Mart.

var. *oahuensis* Mart.

var. *sinensis* (Warb.) Mart.

var. *levigatus* Mart.

HAWAIIAN SPECIMENS WHICH I SAW IN THE HERBARIUMS OF
EUROPE

No. 103b—Gaudichaud in herb. de Candolle. *P. laevis* Warb.?

No. 2256—Seemann (1863) ♂ and leaves, herb. DeCandolle, and Kew.

P. Chamissonii Gaud. }

P. Douglasii Gaud. }

P. Menziesii Gaud. }

phalanges in collection of the Paris Museum.

P. odoratissimus var. *sinensis* = *sandvicensis* Warb., herb. Berol et Martelli.

Setchell no. 15674, *P. odoratissimus* var. *oahuensis* Mart. }

Setchell no. 15673a *P. odoratissimus* var. *levigatus* Mart. } Herb. Martelli.

***Pandanus odoratissimus* var. *levigatus* Mart. n. v.**

Plate 48, figure 2

Arbor circiter 6 m. alta; syncarpium globosum? vel oblongum?; phalanges numerosae, 6 cent. longae, in toto obpyriformes acute-pentagonae, fere dimidiam superiorem partem subprismaticae (24–30 mill. latae), dein usque ad basin angustam (7–9 mill. lata) sensim attenuatae, ibique inter se separatae sed in media parte superiore inter se confertae; politis, lateribus sub-concavis et non semper secundum loculos longitudinaliter leviter sulcatis; apice subrotundatae, supra plano subconvexae, loculis 5–6, subaequalibus mediocribus, vix notatis, aegre convexis, sulcis superficialibus, parvis, divisis, stigma parvum, crassiusculum, verticem loculorum superans. Endocarpium osseum, in sectione longitudinali, 2.5 cent. spissum, praecipue dimidia superiore parte phalangis situm, superne in pyramidem basi latam productum, inferne plano-truncatum; mesocarpium superum cum cavernis exterioribus latis, oblongis medullosis scariosis; mesocarpium inferum compactum, 23 mill. longum.

Habitat.—Hawaiian Islands; Oahu Island, windward shore, Sept., 1926. Setchell, Pl. of Oahu. No. 15673a ♀.

***Pandanus odoratissimus* var. *oahuensis* Mart. n. v.**

Plate 48, figure 1

Arbor elevata, folia crasse coriacea, circiter 1 m. longa, 8 cent. lata, sensim attenuata, longe acuminato-subulata, non caudata; lamina utrinque creberrime minutissime longitudinaliter venata cum pagina superiore, in sicco, nitida, inferiore in basi transverse venulata; marginibus, in extrema basi, inermibus, in reliqua parte serratis, dentibus non approximatis brevibus, rectis, acutis rubescentibus; costa media acuta valde prominenti et fere in tertia parte apicali breviter spinulosa. Syncarpium erectum? pedunculo circiter 20 cent. ♀ longo, 12 cent. crasso, suffultum, globosum, circiter 15 cent. diam. Phalanges numerosae, 6.5 cent. longae, inter se in medio tantum confertae, obpy-

riformes, ambitu lateraliter convexae, 2–2.5 cent. diam., acute hexagonae, basin versus attenuatae in ima basi angustatae, 7–10 mill. crassae, lateribus subconvexis, sine sulcis longitudinalibus, in vertice in toto planae, 6–7 loculis subaequalibus, angulosis, brevibus, acute pyramidatis, a sulcis angustis separatis. Stigma ad verticem loculorum situm, magnum, crassum, subverticale, prominens, hippocrepi-forme. Endocarpium osseum, in sectione longitudinali, in media parte totam latitudinem phalangis replens, superne in toto leviter rotundatum, erosum, inferne subplanum, 25 mill. spissum. Mesocarpium superum longe et late cavernosum medullosospongiosum, inferum fibrosum, compactum.

Habitat.—Hawaiian Islands; Oahu Island, windward shore, trees. Sept., 1926. Setchell, Pl. of Oahu Isl., no. 15674 ♀.

Observations.—The external shape (but only that) of the phalanges is like that of the *Pandanus Rumphii* Gaud. (Bonite, pl. 22, fig. 11) of which typical specimens were gathered in the Moluccas during a voyage of the *Uranie*. They are preserved in the carpological section of the Paris Museum. The locus, the large stigmas, and the smooth lateral faces of the phalanges permit us to distinguish our variety.

PLATE 47

Figs. 1-3. *Pandanus odoratissimus* var. *oahuensis* Mart.

Figs. 4-7. *Pandanus odoratissimus* var. *levigatus* Mart.



A NEW PANDANUS FROM BRITISH BORNEO

BY

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A NEW PANDANUS FROM BRITISH BORNEO

BY

UGLINO MARTELLI

SECTIO PULVISTIGMA Mart.

Drupae. Stigma capitatum, planum, emarginatum in juventute hirsutum dein glabrum. Stamina. . . .

Pandanus Durio Mart. n. sp.

Plate 48

Folia subcoriacea circiter 1 m. longa, lanceolato late linearia, 3 cent. lata, apice sensim attenuato-acuminata, ad basin sensim angustata et canaliculata, extrema basi, brevissimo spatio, late dilatata (7 cent. lata), ibique amplectentia et valide venata; lamina utrinque, sed praecipue in pagina inferiore, longitudinaliter crebre venata, in superiore plicis lateralibus, in parte apicali tantum, irregulariter acute spinuloso-dentatis; marginibus minute serratis, basin versus dentibus majoribus et acuminatis; costa media in pagina inferiore subtili, acuta et prominenti, apicem versus tantum remotiuscule minute spinulosa. Syncarpium terminale, longe pedunculatum solitarium, cernuum, pedunculo subtili, 5 mill. crasso, longitudinaliter, in sicco, crebre minute striato-venoso, foliis floralibus foliis simillimis, sed semper brevioribus, distantibus munito; spathis approximatis sed non vidi. Syncarpium globosum, 8 cent. diam. ex drupis numerosissimis constans. Drupae fusiniformes, 30 mill. longae, in medio 5 mill. crassae, minus quam dimidia superiore parte liberae, et in pyramidem acutissima valide et acute pentagona persaepe apicem incurvatam protractae. Stigma verticem pyramidis replens, capitatum, pulvinatum, brevissime dense hirsutum, sed interdum causa confricamenti, glabrum, planum submarginatum apparet; drupae in dimidia parte penta subprismaticae, in reliqua parte usque ad basim acutissimam sensim attenuatae, connatae et fibrosae. Endocarpium lignosum, infra medium drupae situm, 9 mill. spissum, superne plano-truncatum, inferne attenuato-acutum cum caverna superseminali pyramidata, totam longitudinem partis superioris drupae occupante, squamulosa; mesocarpium inferum fibrosum.

Habitat.—North British Borneo, Bettotan River, near Sandakan. Aug. 4, 1927. C. Boden Kloss, 19059.

Observations.—The leaves (at least the dried ones) resemble those of *Pandanus polycephalus* Lam. The syncarps are of mediocre thickness, and are composed of a number of drupes which in the elongated

portion (pyramidal, free, and horny) are divergent, giving to the syncarps the appearance of a ball of prickles. In general, it resembles somewhat *P. Dankelniamianus*, but is readily distinguished from it by the position of the seed not being at the base of the drupe, and by the stigmas, which are not linear but are situated at the vertex of the acute pyramidal style, which it completely covers. The stigmas are thickly covered with short hairs that form a small cushion. In removing the syncarp, the hairs have been rubbed off, so that they have disappeared and only the flat smooth stigma remains. This appears glabrous and defaced around the edge, resembling somewhat the stigma of some species that Professor Warburg included in his "*Bryantia*" section. Until now, a similar construction of stigma was entirely unknown to me. Unfortunately, we do not possess the male flowers.

PLATE 48

PLATE 48

Pandanus Durio Martelli. C. Boden Kloss, 19059.



**PANDANUS ODORATISSIMUS VAR.
LOUREIRII GAUD**

**BY
UGLINO MARTELLI**

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PANDANUS ODORATISSIMUS VAR. LOUREIRII GAUD.

BY

UGLINO MARTELLI

Pandanus odoratissimus var. Loureirii Gaud.

Bonite tab. 22, fig. 13

P. odoratissimus Lour., Fl. Cochin. II, p. 603, *pro parte*.

P. tectorius var. *Loureirii* Mart., Enum. Pand. in Webbia, 1913, vol. 4, part 1, p. 34.

Folia elongata subcoriacea, sensim attenuata et longe acuminato-subulata, utrinque longitudinaliter minutissime venata; marginibus serratis, dentibus, in parte inferiore, divaricatis, longis, acuminato-subulatis, curvis, interdum subinaequalibus; costa media, in pagina inferiore, acuta, spinuloso-denticulata, basin versus dentibus retroflexis. Syncarpium? Phalanges 5 cent. longae, 2.5–3 cent. (ad apicem), ambitu obpyramidatae, penta-hexagonae sed fere in dimidia superiore parte liberae, sub prismatico-attenuatae, in parte inferiore usque ad basim angustam, sensim attenuatae, lateribus inaequalibus, + — concavo-excavatis vel subplanis. Apice phalangium convexo-rotundato, 5–6–8 loculari; loculis sulcis latiusculis paullum profundis separatis, subaequalibus, angulosis sub-convexis, vertice in stylum robustum plus minus breve elevatum, pyramidatum, abrupte producto. Endocarpium 2 cent. spissum, in sectione longitudinali vix cuneatum, superne sensum in pyramidem latam productum; inferne subtruncatum. Mesocarpium superum cum cavernis centralibus parvis, exterius multo majoribus, mesocarpium inferum fibrosum, circiter 22 mill. longum.

Habitat.—Annam, Indo China, Tourane and vicinity. Omnipresent, roadsides, dunes, thickets, hedges. *Clemens*, 1927; 4343.

Observations.—We have an illustration of the *Pandanus Loureirii* Gaud. on plate 22 of Gaudichaud (Voy. de la Bonite). There are some phalanges gathered by himself which are kept among the collections in the Paris Museum.¹ I consider that the *Pandanus Loureirii* Gaud. is the same as the species Loureiro described under the name,

¹ The ship *La Bonite* during its voyage of circumnavigation landed at Tourane, a classical center for Loureiro's type localities. It is very probable (at least I think so) that even Gaudichaud gathered the phalanges of his *P. Loureirii* near Tourane.

P. odoratissimus, in his *Flora Cochinchinensis* II, p. 602. It is to this variety that I assign the plant gathered by Mrs. Clemens, the phalanges of which I have described above. Also the identity of position: "Dune thickets," and the use the people make of it, planting it along the roadsides like hedges ("ad ducendos sepes agrorum et viarum—amat loca arenota" Lour. *l.c.*), confirm its specific identity.

**RAROTONGA FERNS, COLLECTED BY
HAROLD E. AND SUSAN THEW PARKS**

**BY
EDWIN BINGHAM COPELAND**

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RAROTONGA FERNS, COLLECTED BY HAROLD E. AND SUSAN THEW PARKS

BY
EDWIN BINGHAM COPELAND

Mr. and Mrs. H. E. Parks collected in Rarotonga from May to July, 1930. The flora of this island, the largest of the Cook Island group, has been treated comprehensively by Cheeseman (Trans. Linn. Soc. Bot., 6, 1903). Only those species are noted in this report which I have been unable to recognize as known to Cheeseman, or which seem to me likely to have been identified by him otherwise than as I construe the Parks specimens.

***Angiopteris longifolia* Grev. et Hook.**

Rarotonga: Parks Nos. 22206, 22290, 22493.

Originally collected in the "Society and Pitcairn Islands," and distinguished particularly by the long-caudate apices of the pinnules, fruiting almost to the tip. The most of Parks' material is conspicuous in this respect. The recurrent "veins" are inconspicuous, sometimes almost wanting. The nether surface is squamulose, wherein only is there real deviation from De Vriese's description, Monograph, p. 20, but De Vriese notes scaliness of the pedicels, which is commonly associated with that of the nether surface. This must be the *Angiopteris evecta* of Cheeseman, Trans. Linn. Soc., Bot., 6 (1903), p. 311.

***Trichomanes omphalodes* (Vieillard) C. Chr.**

Rarotonga: Parks Nos. 22016, 22516.

Very fine material, but fruiting sparsely; not in Cheeseman's Flora. Parks did not find *Trichomanes digitatum*, which Cheeseman lists.

***Hymenophyllum involucrellum* Copel. sp. nov.**

Rhizomate late repente radicoso, stipiteque 3-5 cm. alto sursum alato gracilibus, ca. 0.4 mm. crassis, nudis, fuscis; fronde vulgo 10 cm. longa, 4-6 cm. lata, acuminata, basi angustata, flaccida, atroviride, glabra, tripinnatifida, costa fusca ubique anguste alata; segmentis

ultimis sterilibus 0.6–0.9 mm. latis, usque ad 6 mm. longis, integris, apice rotundatis, fertilibus apice dilatatis; soris ad partem superiorem frondis restrictis, ibidem interdum segmenta omnia occupantibus, involuero plerumque obconico, immerso, ca. 1.5 mm. longo et lato, labiis saepius breviter et late rotundatis, interdum fere nullis, rarius longius rotundatis, integris, receptaculo incluso.

Rarotonga, Arorangi; Parks No. 22134, June 3, 1929, "considerable abundance on rocks and trees." Type in Herb. Univ. Calif., No. 392254; also No. 22238.

As the genera are defined, the distinction being by the open sides of the involucre of *Hymenophyllum*, this would be a *Trichomanes*, its involucre having in some cases quite exactly the form of that of *Trichomanes digitatum*, to which no affinity is suggested. Sori with the most developed lips are like those of *Hymenophyllum rarum*, a species with finer axial structures and broader segments. Cheeseman lists *Hymenophyllum polyanthos* Sw. from Rarotonga, as common; but Parks brought back nothing which could have been determined so even by Hooker and Baker, who avowedly used that species to include about thirty of those of van den Bosch.

***Cyathea decurrens* (Hooker) Copel.**

Univ. Calif. Publ. Bot. 14 (1929):356, as to name—bringing synonym.

Alsophila decurrens Hooker, Species Fil. 1 (1844):51.

Rarotonga: Parks, No. 22328.

Fournier, Ann. Sc. Nat. V, 18 (1873):348, has called attention to the rudiment of an indusium on this species. A similar trace is present on the specimens in hand.

This species has, at least locally, a method of reproduction so peculiar that it would be hardly credible if not attested by specimens and photographs. From the old trunk—from any part of it and in considerable numbers, according to Mr. Parks—grow branches, at first ascending, but bending downward, directly or more commonly obliquely, as soon as they are free of the trunk. These are 2–3 cm. in diameter, clothed at the apex and between the leaves with dark-chestnut lanceolate paleae 5–8 mm. long. They bear leaves much smaller than those of the main trunk, and tripinnatifid instead of quadripinnatifid. Where they touch the ground, perhaps a meter or two from the parent trunk, these branches root, and then produce erect trunks of the normal type. The old trunk dies in its time, and leaves a circle of its progeny, already grown, surrounding the dead trunk.

***Cyathea alata* (Fournier) Copel. comb. nov.**

Alsophila alata Copel., Univ. Calif. Publ. Bot., 14 (1929):356, in part;
not *Alsophila decurrens* Hooker.

The study of Parks' Rarotonga collection of *C. decurrens* shows a clear difference, which is obscured, probably by a typographical error in punctuation, in Fournier's description: *C. alata* has a dense cluster of round-ovate paleae at the base of each secondary pinnule, with a very few similar paleae on the costa. *C. decurrens* bears no paleae at the base of costa; along the costa are a few white hairs and a few paleae varying in shape from lanceolate to ovate. The two species are nearly related, but not identical.

***Cyathea Parksiae* Copel. sp. nov.**

Trunco ignoto; stipite 1 m. longo, basi paleis linearibus castaneis nitentibus integris immerso, sursum stipitibusque glabris vel mox glabrescentibus, castaneis, ubique minute nigro-pustulosis; fronde utrinque late rotundata, tripinnata, apice ita breviter acuminata ut apex vera vix ex circumerentia frondis protrudit; pinnis infimis pedicellatis (4 cm.), 20-25 cm. longis, deflexis, more frondis abrupte brev-acuminatis; pinna mediale horizontale, 45 cm. longa, pedicello 2 cm. longo, rhachi in sulca ventrali tomentulosa, alibi tuberculis horrida; pinnulis infimis pedicellis gracilibus usque ad 8 mm. longis protensis, 6-8 cm. longis, medialibus subsessilibus ca. 11 cm. longis, vix 2 cm. latis caudatis, absque costa superne deorsum parce pubescente glabris, herbaceis, pinnatis, pinnulis¹¹ infimis plerumque sessilibus basiscopice dilatatis, sequentibus adnatis et plerisque ala angusta connexis, contiguis, subfalcatis, ca. 11 mm. longis, 3 mm. latis, obtusis, integris vel apice obscure serrulatis; venulis utroque latere ca. 10 plerisque furcatis et soriferis; soris medialibus, latitudinem segmenti fere complentibus, indusio mox fisso, fragmentis persistentibus.

Rarotonga: Maungatea Mountain, alt. 350 m. and up, coll. by Harold E. and Susan Thew Parks and dedicated to the latter. Type No. 22330, in Herb. Univ. Calif., 2 sheets, Nos. 392247 and 392248; also No. 22232, from summit of the mountain.

This notably glabrous species cannot be the *Cyathea Milnei* reported by Cheeseman, but may be the species reported by him as found sterile at the summit of Mount Taitukura.

***Dryopteris tenuifrons* C. Chr.**

I have already (Ferns of Fiji, Bishop Museum Bull. 49: p. 43) interpreted as this species a larger and more compound fern than that described by Brackenridge. Parks has now brought in from Rarotonga, his No. 22147, still larger specimens identical in other respects with his from Fiji. The largest frond measures more than 60 cm. in length, on stipes about equally long. The reddish-tawny paleae densely covering the base reach a length of 25 mm. The curiously appressed darker scales along the stipe, and the mixture of scales and hairs on the axes of the frond, are quite alike on Fiji and Rarotonga specimens. This may be the *Nephrodium decompositum* of Cheeseman's Flora; its double indument, of scales and hairs, distinguishes it from that species, but we have other evidence that he did not discriminate finely in the use of the name.

Another similar fern, collected in Rarotonga three times by Parks, seems to me to represent *Dryopteris dissecta* (Forster) O. K. Its axes are rather densely clothed with a very short pubescence. There is an occasional anastomosis of veinlets where the fronds are least dissected, as I have observed to occur in the same species from other parts of Oceania. This may have caused it to be mistaken for *Tectaria leuzeana*; at any rate that species, reported as common in Rarotonga, is not in Parks collection.

***Dryopteris obstructa* Copel. sp. nov.**

Goniopteris, rhizomate repente, sicco 8–12 mm. crasso; stipite 1 m. alto, valido, ad basin paleis fuscis parvis vestito, alibi squamulis amorphis pilisque minutis asperso, basi dilatato superne (ventraliter) concavo, sursum eadem facie sulcato vel in siccitate trisulcato, tota longitudine cicatricibus oblongo-orbicularibus remotis (5 cm.) biseriatis ornato; fronde ca. 1 m. alta, 30–35 cm. lata, abrupte acuminata segmento apicale 8 cm. longo pinnatifido, alibi pinnata, pinnis infimis vix abbreviatis horizontalibus, rhachi superne pilosa inferne glabrescente; pinnis maximis vix 20 cm. longis, 2 cm. latis, e basi paullo dilatata usque ad caudam angustam integram brevem sensim angustatis, contiguis, sessilibus pulvino piloso ad rhachin articulatis, papyraceis, superne costa sparse setulosa excepta nudis, inferne apicem versus venae secundariae medialis pilis nonnullis plerumque praeditis alibi glabris, medio ad costam pinnatifidis, segmentis ca. 4 mm. latis obtusis integris; venulis simplicibus, ca. 11-paribus, quarum anastomosantibus ca. 4-paribus venam secundariam validam superne sulcatam in dentem deflexum angustam excurrentem efficientibus; soris medialibus, fere 1 mm. latis, contiguis, nudis.

Rarotonga: Avatiu valley, Parks No. 22536; July, 1929. Type in Herb. Univ. Calif., No. 392249.

Most like the Fijian *D. microsora*, from which it differs in more naked fronds, narrower lobes, larger sori, and naked sporangia. The specific name refers to the tooth produced by the secondary vein, preventing the passage of water through the sinus to the nether surface.

Under the same field number, Parks brought in fronds of another species with pubescent fronds and persistent, naked indusia.

***Athyrium enorme* Copel. sp. nov.**

Diplazium, caudice teste lectore erecto, basibus stipitum paleis aterrimis usque ad 25 mm. longis basi 2–3 mm. latis valde attenuatis et ibidem tortis vestitis; fronde stipite incluso usque ad 3 m. alta; stipite valido, fusco; sursum rhachique nudis; fronde apice breviaminata pinnatifida, parte bipinnatifida etiam breve (15 cm. longa), alibi tripinnatifida, glabra, herbacea; pinna mediale 50 cm. longa, brevistipitulata (1 cm.), abrupte et breviter acuminata; pinnulis infimis maximis, 12 cm. longis, 4 cm. latis, acuminatis, basi truncatis, breviter (1–2 mm.) stipitulatis, profunde (2 mm. a costa) pinnatifidis, sursum (in sensu pinnae) sensim decrescentibus, contiguis; lobis usque ad 7 mm. latis, obtusis, serratis vel apice dentatis; venis plerisque simplicibus; soris a costa lobi usque ad marginem protensis, infimis usque ad 7 mm. longis, infimis solummodo, nisi venarum furcatarum, diplazioides, indusiis brunneis angustis; sporangiis magnis, brevipedicellatis, annulis atrocastaneis.

Rarotonga: Maungatea. Parks No. 22495. Type in Herb. Univ. Calif., two sheets, Nos. 392250 and 392251; also Nos. 20150, 22569.

This is probably the *Asplenium arborescens* of Cheeseman.

***Asplenium schizotrichum* Copel. sp. nov.**

Rhizomate breve, adscendente, cum basibus stipitum paleis atrocastaneis linearibus longe attenuatis 5–7 mm. longis vestito; stipitibus caespitosis, 30 cm. altis, atris, squamulis plerisque deciduis vestitis; fronde 35–45 cm. alta, 6–8 cm. lata, basi paullo angustata, apice breviaminata pinnatifida, alibi pinnata; rhachi atra, squamulis basi brunneis in ramulas filiformes obscuras fissis vestita; pinnis utroque latere 20–25, subsessilibus, oblique lanceolato-ovatis, acutis, late et breviter auriculatis, basi basicopica cuneatis, praecipue apices versus grosse serratis, papyraceis, superne fere glabris, inferne pallidioribus squamulis irregulariter ramosis adpersis; venis subconspicuis; soris utroque latere costae uniseriatis, obliquis (haud flabellatis), medialibus vel inframedialibus, ca. 5 mm. longis.

Rarotonga: Parks No. 22023 *partim*. Type in Herb. Univ. Calif., No. 392253.

Because of his comment—"Differs from the typical state in the pinnae being hardly lobed and broader," I suspect that this is the *Asplenium falcatum* of Cheeseman's Flora. It is not, however, any near relative of that species. In spite of the very different shape of pinnae and position of sori, it has more affinity to *A. horridum* than to *A. falcatum*.

***Asplenium Parksii* Copel. sp. nov.**

Plate 49b

A. epiphyticum gregis A. insititii, rhizomate adscendente, radicibus paleisque atrocastaneis linearibus anguste acuminatis oblecto; stipitibus seriatis approximatis, atrocastaneis, nitidis, deorsum paleis iisdem ornatis, sursum rhachibusque nudis, 6–10 cm. longis; fronde lineari-lanceolata, usque ad 30 cm. alta et 5 cm. lata, vix bipinnata, acuminata, apice 2–3 cm. longa grosse incisa segmentis angustis subrectis, segmentis infraapicalibus paucis adnatis cuneatis apice incisodentatis; pinnis superioribus brevipedicellatis, ellipticis, basi obliquis, margine acroscopica et exteriori incisodentatis, segmentis vix 1 mm. latis obtusis; pinnis medialibus maximis patentibus, glabris, herbaceis, 3 cm. longis, 16 mm. latis, oblique ovatis, basi basiscopica excisa acroscopica truncata, apice rotundata, profunde incisis, segmento infimo acroscopico maximo fere libero 7 mm. lato, sequentibus paucis minoribus angustioribus, late confluentibus (pinnis ibidem leviter incisis), apicibus segmentorum omnium incisodentatis, soris medialibus; indusio 1 mm. lato, viride fuscescente.

Rarotonga: Parks No. 22023 *partim*. Type in Herb. Univ. Calif., No. 392252.

Small plants in full fruit have a single half-free lobe on the upper side of each medial and basal pinna. I do not confidently identify this with any species in Cheeseman's Flora, although some are unrepresented in Parks' collection. Possibly it is his *A. cuneatum*, to which and to *A. affine* it has some affinity, but from both of which it differs most conspicuously in the rounded and less cut pinnae. Its greatest similarity is to the Hawaiian *A. lobulatum* Mett., a species with more cut and proliferous fronds. The small specimens with comparatively entire pinnae stand in a similar relation to the Hawaiian *A. pseudofalcatum* Hilleb., the two Hawaiian species named being very closely related.

Whether or not they are identical, *A. pseudofalcatum* is hardly distinguishable from the Philippine *Asplenium Steerei* Harr., named eleven years earlier, which is closely related to a species typically of very different aspect, *Asplenium acutiusculum* Bl. (as *Asplenium anisodontum* Presl.). *A. pseudofalcatum* var. *subintegra* Rosenstock,

based on Faurie No. 455 of 1914, from Formosa, is typical *A. Steerei*, as represented by a fragment of the type in my herbarium. *Faurie No. 456* is a better developed form of the same species.

***Davallia epiphylla* (Forst.) Spr.**

Rarotonga: apparently common. This is the *Davallia elegans* of Cheeseman's Flora. The reduction of that species to *D. denticulata* (Burm.) Mett. is probably correct, but this Polynesian fern is as distinct now as it was in the days of Swartz and of Hooker's Species Filicum. I identify the Rarotonga fern as *D. elata*, but call it *D. epiphylla* on the statement of Hooker, *loc. cit.*, vol. 1, p. 166, that they are one species in the Banksian herbarium. Of Malayan ferns, my *D. embolostegia* is near this, but *D. denticulata* has a very different indusium.

***Cyclophorus macrocarpus* (H. & A.) Copel. comb. nov.**

Niphobolus macrocarpus H. & A., Bot. Beechey's Voyage, p. 74, pl. 18.

Evidently common in Rarotonga from the strand up to at least 400 feet altitude.

Most conspicuously distinguished from *C. angustatus* (Sw.) Desv. by the obtuse fronds, the sterile ones being very broadly rounded. The stellate paleae are somewhat smaller, less than 0.5 mm. in diameter, and mostly dark-centered. The paleae of the rhizome become ragged-ciliate before the pale-tawny, spreading distal portions are lost.

All reports of *C. angustatus* from Polynesia probably refer to *C. macrocarpus*. Neither species is known from Papua.

***Polypodium vitiense* Baker**

P. expansum Baker, Jour. of Bot., 14 (1876):12, non Poir.

The error in confusing this Polynesian fern with *P. dilatatum* Wall., now known as *P. euryphyllum* C. Chr., to which I have previously called attention (Ferns of Fiji, 1929:94), was corrected by Baker, prior to his publication of an imperfect form as *P. vitiense* (1879), but the name he adopted had been used long before. The fern was reported from Rarotonga by Cheeseman, as *P. expansum*, and is represented anew by Parks, Nos. 22041, 22084, and 22355.

MISCELLANEOUS ORIENTAL PTERIDOPHYTES

BY

EDWIN BINGHAM COPELAND

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MISCELLANEOUS ORIENTAL PTERIDOPHYTES

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***Lycopodium Somae* Hayata**

Icones Pl. Formosanarum 5 (1915):255

Luzon. Clemens Nos. 16306 (Dec., 1925) and 7687a (Dec., 1926), both collected along the trail from Pauai to Mt. Data, and said to be from the same locality, probably in Benguet Province. Terrestrial.

Previously known only from Formosa. As stated by Hayata, this is a relative of *L. lucidulum*. It is much closer to *L. miniatum* Spr., from which it differs solely in size, being much smaller as a whole, and in all parts. The coloration is identical. In the University of California Herbarium, these Clemens specimens were labeled *L. halconense*, and they may have been distributed, so named, but that species belongs in the small group with short, lateral fertile branches.

***Lycopodium tenuifolium* Herter**

Engler's Jahrb. 43, Beiblatt 98 (1909):41.

Faurie, No. 322, July, 1908, from Sagalien, seems to be this species, extending its range to that island. In the other direction, I suspect it of reaching Formosa, as *Lycopodium reflexointegrum* Hayata. This would probably have been included by Baker in *Lycopodium lucidulum*. Faurie and Taquet collected in Korea three specimens, Nos. 59 and 2493 of Taquet and 2186 of Faurie, October and July, 1907, which may represent that species, and may be *L. sinense* Christ. The No. 2493 comes to us identified as *L. sinense*, whether or not by Christ is not evident.

In attempting the generic separation of this group from *Lycopodium* and its inclusion in *Urostachys* as a genus characterized by uniform dichotomy, Herter goes contrary to the facts as well as to the usual judgment of his predecessors. Dealing with unquestionable relatives of *Lycopodium Selago* and of *L. lucidulum*, Hayata (p. 252) has maintained a proper distinction of "Rhizoma (vel in sensu vero caulis repens)" and "Caulis (vel in sensu vero ramus)," as is fully

proved by his photographs. While the specimen seen by Herter may not show it, the *L. Selago* of Mount Kinabalu (cf. Phil. Jour. Sci., 29 (1923):179) has the same distinction of stems—witness, the accompanying photograph, plate 1, *a*. This did not impress me, when naming the Kinabalu collection, as demanding its specific separation; and it will take a zealous genus-splitter indeed to hold it and the Formosa plants generically distinct from *L. Selago* and *L. lucidulum*. *Lycopodium serratum*, well collected, often shows a similar distinction of erect dichotomous branches and prostrate rather monopodial stems. Comparison with the foregoing leads me to regard Arctic specimens of *L. Selago* and typical *L. lucidulum* as plants with the same growth pattern, but more condensed, so that the dichotomy is relatively conspicuous.

Even if Herter's removal of these species from *Lycopodium* is expedient, the occasion for a new name is not evident. *Plananthus* is more than a century older, clearly enough typified, and taken up by several authors during the interval, but apparently overlooked by Pritzel and Herter.

Not believing that Herter's *Urostachys* is a proper genus, whatever its name, I include in *Lycopodium* some of his species which have no names there, as follows:

***Lycopodium Whitfordi* (Herter) comb. nov.**

Urostachys Whitfordi Herter, Phil. Jour. Sci. 22 (1923):63.

***Lycopodium Merrillii* (Herter) comb. nov.**

Urostachys Merrillii Herter, Phil. Jour. Sci. 22 (1923):64.

***Lycopodium banayanicum* (Herter) comb. nov.**

Urostachys banayanicus Herter, Phil. Jour. Sci. 22 (1923):66.

***Lycopodium Delbrückii* (Herter) comb. nov.**

Urostachys Delbrückii Herter, Phil. Jour. Sci. 22 (1923):68.

***Lycopodium Sieboldi* Miq.**

Ann. Bot. Lugd.-Bat. 3 (1857):184

L. Fargesii Herter, Engler's Jahrb. 43, Beiblatt 98 (1909):48.(?)

L. Christensenianum Christ et Herter, Hedwigia 49 (1909):89.

L. tereticaule Hayata, Icones Pl. Formos., 4 (1914):133.

L. Fauriei Rosenstock, Hedwigia 56 (1915):348.

In the reaction from the comprehensive species-concept of Hooker and his disciples, we go easily to the other extreme. In the floras we know really well, we recognize the wide variability of many of our species, knowing intermediate forms between the extremes of distinct appearance. In dealing with the comparatively few specimens from remote lands, which we have a chance to see, these intermediate forms may remain long unknown, while the extreme forms seem to represent very distinct species. In the presence of this inevitable occasion for the setting up of too many species, it besseems us to be particularly cautious about formulating specific diagnoses which are really the descriptions of individual specimens. It sticks in my memory that the foremost pteridologist of his day insisted upon the specific distinctness of two fronds from one Mindanao plant of *Marattia*. Were Europe a new country under exploration and with its ferns being described in Japan or California, we should be very apt to construe the European forms of *Polypodium vulgare* as several species: and we should really be describing individuals. I suspect that this is what Herter has done with *Lycopodiums* collected, for example, by Farges in China and by Mrs. Clemens in Mindanao.

In an attempt to clarify this species or group, it is convenient to begin with *L. Christensenianum*. This was based on a collection by Farges, No. 1562, from Tchen-kéon-tin, in Sze-Chouan, from the Paris Museum, "une grande quantité d'échantillons de différents dimensions." It was distinguished from *L. Sieboldi*, as described by Baker, Fern Allies, p. 13, by the uniform, non-imbricate, "multifarius," ecostate leaves and less branched stems of the latter. If we go back to Miquel for a more authoritative description of *L. Sieboldi*, we find that the leaves are "imbricata vel subimbricata," "8-6-sticha (passim etiam opposita)," "foliorum carina magis minusve perspicue obtusula nunc manifesta nunc non decurrens," and there is only inference that the stems are not very many times forked. Unless possibly in the dimorphism of the leaves, there certainly remains no good ground, based on descriptions, for supposing the species to be distinct.

L. Fargesii, published earlier in 1909, was based on material in the Paris Museum, *Farges No. 1892*, from the same locality. Its diagnosis and that of *L. Christensenianum* look quite unlike, dealing in part with different features. Dimorphism of leaves is emphasized in describing the latter; but the leaves of the former are "plerumque . . . linearia . . . ad apicem . . . rhomboides"; they are "interdum carinata." We have from the Paris Museum three sheets of

specimens collected by Farges at Tchen-kéon-tin, without stated number, altogether "une grande quantité d'échantillons de différents dimensions," all positively representing a single species, all received as *L. Sieboldi*, but conforming, here to the diagnosis of that species by Miquel, here rather to its description by Baker, here to the diagnosis of *L. Fargesii* except that no leaves are quite so long as stated by Herter (up to 4 mm.), here to that of *L. Christensenianum* except that the colorless, scarious margins are inconspicuous (as to which, cf. Miquel); and these differences are manifested in any desired combination on branches of single plants, still connected on our sheets. We have also from Quelpaert a collection by Taquet, more completely conformable to Baker's description.

The two supposed Formosan species have already been combined by Hayata, *Icones Pl. Form.*, 8:156. These are identical with the portions of the Farges collection where the leaves are curved strongly upward and inward but not appressed. Without the Farges material, one would hardly suspect their identity with the Taquet specimen with broader, shorter, appressed leaves.

Gleichenia hirta Bl.

Enumeratio (1828):250

Dicranopteris dolosa Copel. Perkins' *Fragmenta* (1905):193.

Gleichenia dolosa C. Chr., *Index* (1905):664.

Gleichenia candida Rosenst., Fedde's *Repert.* 5 (1908):33.

The type locality of *G. hirta* was the Moluccas. Mettenius, *Ann. Lugd., Bot.* 1:48, with material from Tidore, presented a more complete description—more complete than is appropriate in some respects, as I construe the species. I have not seen type or topotypic specimens, but am sure that, if our collections include two species in this group, they include at least four. The early American collections showed the fern termed *G. dolosa* to be widespread in the Philippines, and so inconstant that I soon felt constrained (Elmer's *Leaflets*, 2 (1908):424) to reduce it to *G. hirta*. At about the same time I received from Papua, from Copland King, a specimen too similar for specific discrimination—*Phil. Jour. Sci.* 6 (1911):68. Within the same range of variation is the plant collected, in Kaiser Wilhelmsland by Schlechter, No. 19842, and distributed as *G. hirta*. *G. candida* was distinguished from *G. hirta* "ausser durch die Farbe noch durch kräftigere Achsen, starre Textur und bedeutend kürzere, kaum etwas nach vorn geneigte und scharf zugespitzte Segmente." The only item

among these which might distinguish it from *G. dolosa* is the texture; and it is less coriaceous than a specimen from northern Luzon, Van-overburgh No. 1247, which I refer to that species, respectively to *G. hirta*. Philippine specimens range from slightly to very densely glaucous, usually beautifully pale blue beneath, but sometimes almost white. Its segments are usually obtuse but sometimes acute; those of the type collection of *G. candida* are mostly acute, but matchable in this respect by some Philippine collections. Typical *G. candida* has wider segments and less chaffy axes than are usual in *G. dolosa*; as to these distinctions, King's plant and one collected in New Guinea by Bamler, distributed without number by Rosenstock as "*Gleichenia candida* Ros. forma," are typical *G. dolosa* in shape and size of segments, and they approach it in scaliness. Agreeing with Rosenstock that Bamler's fern represents a form of *G. candida*, I am unable to distinguish that species from *G. dolosa*, and suppose both to be *G. hirta*, which is thus one of the considerable number of ferns ranging from New Guinea across the Philippines.

The first report of *G. hirta* from farther west seems to be in Synopsis Filicum, p. 14, based on a collection by Sir W. Norris, from Penang—Beddome, Ferns of Brit. India and Ceylon, Suppl., p. 2. Both Baker and Beddome contented themselves with a translation of Mettenius' description of Reinwardt's specimen from Tidore. I have not seen Norris' specimen, but presume that it is the following apparently distinguishable species.

***Gleichenia peninsularis* Copel. sp. nov.**

G. hirtae affinis, rhizomate late repente, 5 mm. crasso, paleis atro-castaneis anguste lanceolatis valde attenuatis brevissime ciliatis patentibus rigidis persistentibus 4 mm. longis vestito, stipite castaneo deorsum paleis paucis similibus sed filiformi-attenuatis praedito, sursum glabrescente sed laminam versus pilis nonnullis permanentioribus fere filiformibus castaneo-fulvis ciliatis contortis 1-3 mm. longis vestito; fronde pinnata; pinnis 2-3-dichotomis, internodis infimis 1 vel 2 lamina carentibus superioribus 1 vel 2 pectinato-alatis; ramis ultimis ca. 35 cm. longis, ca. 3 cm. latis, praecipue sursum sensim angustatis, vix ad costam nudam pinnatifidis; segmentis lineariblongis, late patentibus, usque ad 17 mm. longis, 3-4 mm. latis, obtusis vel subacutis, apice serrulatis, margine planis vel leviter deflexis, glabris, tenuiter coriaceis, inferne plus minus azureo-glaucis; soris parvis, medialibus.

Malay Peninsula: Type, Singapore Field No. 19767, Herb. Univ. Calif. No. 346256, Kedan Peak, alt. 1000 m., 1. Abdul Kadir, April 9, 1928; collected also by Holtum, Gunung Belunut, No. 10689; Md. Haniff, near Tiger Hill, Penang, No. 17397.

Distinguished from *G. hirta* by the comparative absence of paleae, and by the extreme narrowness of the paleae present on the lower rachises and the top of the stipe. This has more resemblance to the New Guinea form described as *G. candida* than to the Philippine form described as *G. dolosa*.

Gleichenia Brackenridgei Fourn.

Aneityum: Anelgauhat Bay, alt. 2500 ft. Kajewski No. 873.

Already known from New Caledonia and Fiji, this was to be expected in the New Hebrides.

Gleichenia oceanica Kuhn.

Tanna, alt. 800 m. Kajewski No. 161.

Described from Aneityum, and ranging to Samoa. Distinguished from *G. Brackenridgei* by being glaucous beneath, with naked lamina, and the axes less beset by lacerate scales and hairs. They may blend; *G. oceanica* is the older name.

Hymenophyllum feejeense Brack.

U. S. Expl. Exped. 16 (1854): 266, pl. 37, f. 2.

Collected in Fiji in 1927 by H. E. Parks, No. 20808, in part, but not in my hands when preparing the report on his collection—Bishop Museum Bull. 59 (1929):29.

It has been customary to construe this as *Hymenophyllum multifidum* (Forster) Swartz. It conforms to Forster's description, as does also a New Zealand fern with the valves of the involucre larger and entire or nearly so. Unless by inference, Forster (Prodromus, p. 85) cited no locality; from his stating the shape of the valves and not mentioning the margin, as entire or toothed, I would assume that it was inconspicuous, and therefore entire, and that his was the New Zealand plant. Schkuhr, pl. 135 B, figured a sterile specimen of Forster's collection. The valves of *H. feejeense* are most conspicuously toothed. The receptacle was described as included, but some of Parks' specimens have it exerted, to a degree unusual in the genus.

Trichomanes caudatum Brack.

Fiji: Parks No. 20808 in part.

The material is uniformly smaller than as described, and wants the beautiful uniformity of outline pictured by Brackenridge, but the identity is positive; by the courtesy of the U. S. National Herbarium, I have the type in hand.

***Cyathea Setchellii* Copel. n. sp.**

Plate 50

Trunco, teste lectore, breve; fronde 150 cm. longa, subtripinnata; stipite 8 cm. longo, ad basin paleis laete fulvis linea castanea mediale castanea percursis subintegris anguste lanceolatis 1 cm. longis vestito, alibi furfuraceo; rhachi laete fusca, deorsum punctulis minutis asperula, sursum molle, in sulca ventrali velutina, alibi glabrescente; pinnis infimis remotis, vix 4 cm. longis, pinnatis; medialibus 45 cm. longis, 20 cm. latis, brevissime (4 mm.) stipitulatis, abrupte acuminatis; pinnulis infimis pinnarum maximarum paullo abbreviatis, sequentibus 11 cm. longis, 3 cm. latis, sessilibus, acuminatis cauda serrata, ad basin pinnatis, pinnula basiscopica sessile, acroscopica adnata, alibi pinnatifidis, costa inferne apud basin paleis obscuris angustis 1 mm. longis ornata, alibi fibrillosa vel apicem versus nuda; segmentis 5 mm. latis, rectis vel subfalcatis, obtusis, serrulatis, papyraceis, inferne pallidioribus, costa inferne squamulis paucis minutis integris bullatis ornata; venis furcatis, infima basiscopica e costa pinnulae oriente; soris medialibus vel inframedialibus, magnis, indusio fulvo, mox fisso sed persistente.

Samoa: Pago Pago, near the shore, coll. *W. A. Setchell No. 2*, June, 1920; Nom. vulg. "Olioli." Type in Herb. Univ. Calif *No. 216030*; also No. 225, trail from Aua to Aofono.

Near *Cyathea propinqua* Mett., and once so determined; that species, a Fiji fern, differs, however, in having a prickly stipe clothed with harsh, dark paleae, pinnules nowhere quite pinnate, and in being without bullate scales. Other Samoan species in the same general group are *C. Vaupelii*, with narrow and obtuse pinnules; *C. Betchei*, with more ample, lax, and divided fronds; and *C. deorsilobata*, with segments or pinnules entire near the apex but incisoserrate near the base—all of the foregoing described in the Philippine Journal of Science, 6 (1911):359 and 360, and previously called *C. propinqua*, which I have seen from Fiji only.

***Cyathea laciniata* Copel.**

Fronde tripinnata, herbacea, inerme, rhachi brunnea superne paleis castaneis filiformibus debilibus 5–8 mm. ubique densissime ciliatis ornata; pinna acuta subsessile, 35 cm. longa, 10 cm. lata, rhachi inferne pilulifera glabrescente; pinnulis sessilibus, basi obliquis, 16 mm. latis, acutis v. breviter acuminatis, costis fuscis superne dense albido-pilosis, inferne et paleis angustissimis castaneis et pilis pallidioribus vestitis; pinnulis^{et} infimis sessilibus, sequentibus adnatis, plerisque confluentibus (deinde vero laciniis), haud contiguus, 2.5–3.0 mm. latis, obtusis, infimis lobatis, aliis serratis, superne atroviridibus inferne olivaceis, costis inferne pilis paucis pallidis ornatis; venis furcatis, ramo supe-

riore saepe furcato; soris in alas ultimas positus, utroque latere costae in seriam unam medialem vel deorsum margini propiorem instructis, parvis; indusio tenue sporangia immatura jam imperfecte tegente.

Aneityum: Angelauihat Bay, alt. 2000 ft., common in rain forest. Kajewski, No. 876. March 5, 1929. "Small tree fern 9 ft. high with fronds 5 ft. long."

In dissection and texture, this is a very peculiar *Cyathea*. The indusium is very promptly reduced to a cup, wherefore a botanist disposed to recognize an arbitrarily defined genus *Hemitelia* would be likely to include this in it. Only the hairiness, which is not very conspicuous, makes me hesitate to identify this as *Hemitelia laciniata* Spr.; in spite of this I have thought it best to use this specific name.

***Cyathea rugosula* Copel. sp. nov.**

Alsophila, trunco alto, 15–25 cm. diametro, stipite longo, basi 2.5 cm. crasso fusco paleis linearibus et setiformibus 4 cm. longis albido-fuscis minutissime et decidue castaneo-ciliatis immerso, utroque latere serie fere continua cicatricum elongatarum ornato, sursum pallidiores submolle; fronde magna, subtripinnata, rhachi fulva tuberculis duris 0.5–0.7 mm. crassis et altis dense obsita superne in sulca pilosa; pinnis subsessilibus, 45 cm. longis, 18 cm. latis, abrupte et breviter acuminatis; pinnulis contiguas, 10 cm. longis, vix 2 cm. latis (infimis paullo brevioribus), acuminatis, sessilibus, vix ad costam pinnatis, costa superne deorsum sparse pilosa, inferne paleis ochroleucis bullatis ciliatis 0.5 mm. longis multis, aliisque majoribus planis perpauca caducis ornata; segmentis 2.5 mm. latis, rectis vel subfalcatis, obtusis, serrulatis, coriaceis, fertilibus subbullatis et rugosulis, superne obscure, inferne pallide viridibus, costulis deorsum squamulis bullatis descriptis obsitis; venis ca. 12-paribus, furcatis; soris medialibus, totam laminam demum complentibus, indusiis invisibilibus.

Eua Island, Tonga; *Parks* No. 16016, in jungle, alt. 200 m. Type in Herb. Univ. Calif. No. 297619; also, in same region and up to 300 m. alt., *Nos.* 16032 and 16226.

This is near to *Cyathea extensa* (Forst.) Sw. Possibly it is that species, but it is not the Fiji species to which I have applied that name. They differ most conspicuously in the paleae at the base of the stipe—very long and slender and pale in the Eua plant, small and dark in that of Fiji. The Eua plant is larger, as a whole and in all its parts.

In the damp places, *Parks* reports trunks reaching to a height of 15 meters or more. Specimens brought in representing these trunks shows scars 4 centimeters wide and 10.5 centimeters long. On the more exposed plateau, the plants are comparatively short and the slower growth finds expression in the form of the scars, which are quite uniformly 4 centimeters wide by 6 centimeters long. The pattern of

the bundle traces on these scars is the same in both but the profound change in form of the scars as a whole, with the difference in environment, shows that the form of the scar has only a limited value as a specific characteristic.

***Monachosorum gracile* Copel. sp. nov.**

Ab *M. subdigitato* segmentis minoribus plerisque monosoris, soris majoribus, fronde fere quinquepinnata distinguendum.

New Guinea: Bolan. alt. 3400-3800 m. Keysser No. B27. 1912. Type in Herb. Univ. Calif., No. 391415.

This was reported as *M. subdigitatum* by Rosenstock, Fedde's Repert. 12 (1913):162, which seems to have been the only report of the genus from New Guinea, and to have been overlooked in Brause's enumeration. It is effectively once more pinnate than *M. subdigitatum*, so that the "teeth" of that species are in this one segments, connected only by a wing of the vein. *M. subdigitatum* is far from uniform in dissection, but none of the numerous specimens in hand approaches *M. gracile* in fineness. The sori of the New Guinea specimen have usually twenty or more sporangia—twenty being commoner than ten is on *M. subdigitatum*. The pubescence is alike in character, but denser or more persistent on the axes of *M. gracile*. On the part-frond in hand, the pinnae are alternate and remote, but they may well be opposite at the base.

***Dryopteris euaensis* Copel. sp. nov.**

Lastraea, rhizomate repente, 6 mm. crasso, paleis atrocastaneis linearibus 8 mm. longis vestito; stipitibus haud remotis, 20-30 cm. altis, ad pedem paleis parvis vestitis, sursum minute et sparse pubescentibus; fronde 60-70 cm. alta, ca. 20 cm. lata, abrupte acuminata, deorsum gradatim angustata, profunde bipinnatifida; rhachi pilis ca. 0.3 mm. longis sat dense pubescente, obscure quadrata; pinnis sessilibus, linearibus, erecto-patentibus, acuminatis, basi truncatis, plerumque praecipue acroscopice paullo dilatatis, medialibus ca. 13 cm. longis, 15 mm. (ad basin usque ad 17 mm.) latis, ad alam 1 mm. latam pinnatifidis, utraque facie (praecipue venis et margine) sparse pilosis, tenuiter herbaceis; segmentis 2.5-3.0 mm. latis, sinu acuto separatis, obtusis, integris; venulis ca. 9-paribus, liberis, simplicibus; soris medialibus vel margini paullo propioribus, parvis, paraphysibus ochroleucis nitidis obscuriscentibus praeditis; indusio castaneo, nudo, persistente, 0.5-0.6 mm. lato.

Eua Island, Tonga, in edge of thick forest, alt. 300 m. *Parks* No. 16268, June 30, 1926, type, in Herb. Univ. Calif. No. 401302; also, *Nos.* 16286 and 16298, same habitat.

This species seems to be nearest to *D. Harveyi*, among the strictly free-veined species of its part of the world. The lower pinnae dwindle very gradually and are increasingly remote, but the lowest are still well developed, two to four centimeters long, and deeply pinnatifid. The dimensions of No. 16298 somewhat exceed those of the type and description.

***Dryopteris microthecia* (Fée) C. Chr.**

Bamler No. 103, from New Guinea: Sattelberg, al. 800–900 m., has the pinnae more deeply pinnatifid than does my specimen of the type collection, *Cuming No. 13*, and rather more so than in any Philippine example in hand. It is, however, clearly this species, not *D. sagenioides* as distributed, which has a black rachis. A variety (as of *Dryopteris metteniana* Hieron.) *novoguineensis* Brause, Bot. Jahrb. 56 (1920):93, has been described from New Guinea, with narrow sinuses, and the lowest basiscopic segment of each pinna shortened and against the rachis. These features occur now and then in the Philippines. Specimens with broadly rounded sinuses have them protected against the flow of water to the nether surface with a sharp tooth, as in *D. symatica*.

***Dryopteris emigrans* Copel. nomen nov.**

Aspidium concinnum Thwaites Enum. Ceyl. Pl. (1864) 392, nec. Link, nec. Mett.

Nephrodium Thwaitesii Baker, non *Meniscium Thwaitesii* Hooker=*Dryopteris Thwaitesii* O.K.

This is treated by Christensen as a form of *D. deparioides*, following a suggestion which goes back to Thwaites. However, Thwaites, and Beddome, and Wall, all preferred to construe it as a valid species. In the other direction (the ancestral), its affinity is to *D. sparsa*, which fairly runs wild in Ceylon in diversity of forms—see Wall's Catalogue of Ferns Indigenous to Ceylon (1873), p. 5 of the Notes.

***Dryopteris macroptera* Copel. sp. nov.**

Rhizomate ignoto; stipite (usque ad pinnas infimas normales) 70 cm. alto, valido, sursum pinnis aliquot minutis valde remotis ornato, prope basin paleis castaneis integris 1 cm. longis 3 mm. latis vestito, sursum inconspicue pubescente; fronde 120–150 cm. longa, abrupte acuminata, basi truncata, bipinnatifida; rhachi pilosa pilis albidis 0.5–0.8 mm. longis; pinnis permultis, proximis, sessilibus, linearibus, acuminatis, basi oblique truncatis, 25–28 cm. longis, 18–24 mm. latis,

ultra mediam laminam pinnatifidis, costa superne sparse pilosa, margine sparse et decidue ciliata, aliter glaberrimis, tenuiter herbaceis; segmentis contiguis, apice rotundatis, 4-5 mm. latis, integris; venulis simplicibus, 11-13-paribus, infimis anastomosantibus et venam ad sinum cartilagineum deflexum excurrentem efformantibus, venula sequente plerumque utroque latere una ad vel infra sinum etiam cum excurrente connexa; soris medialibus, parvis; indusio minuto et mox evanido, nudo.

Eua Island, Tonga, *Parks No. 16177*, type, Herb. Univ. Calif. No. 297587, in wet forest on plateau, alt. 200-300 m., June 26, 1926; also, *No. 16040*, in wet canyon, alt. 100 m.

Related to *D. hudsoniana* and *D. magnifica*, from both of which it is conveniently distinguished by the minute and transient indusium. *No. 16040* includes one frond smaller than the others in hand, with pinnae hardly 15 mm. wide, but up to 18 cm. long, the lobes 2-3 mm. wide and not contiguous, but still with parallel sides, and mostly a single pair of anastomosing veins; it is in full fruit.

Dryopteris rubrinervis (Mett.) C. Chr.

Tanna: common at sea level.

Kajewski No. 61.

The specimen is sterile. Its conspicuously reddish costae and main veins leave little doubt that this identification is correct. Kajewski collected in Aneityum (No. 858) a specimen with the entire lamina reddish, but with no concentration of the color in the veins. I regard it as *D. urophylla*, and suppose that the two collections represent one species.

Currantia oyamensis (Baker) Copel.

As a New Guinea species, this was described as *Dryopteris genuflexa* (an excellent name) by Rosenstock, who presently corrected it to *Dryopteris oyamensis*, Fedde's Repert., 12 (1913):530. Christensen, Index, Suppl. II (1917):14, questioned this reduction, which a *pricri* seemed improbable enough. It seems to have been found but once in New Guinea, and examination of this collection shows no ground for questioning Rosenstock's judgment. Assuming that its distribution is as discontinuous as now appears, and that it never occupied the intermediate area, as a whole—that is, that it has colonized one area from the other by a great jump—the wind and birds suggest themselves as the agents. The opportunity for the spores of exposed montane ferns to be carried to great distances by the wind is clear and well recog-

nized. But there is likewise the constant possibility of the conveyance of the spores by migratory birds of very sustained flight. Many spores must be so carried, but only vigorous spores, and then only those deposited in fit places, effect colonization in this way. Vigor of spores is a prime qualification of a fern in order to be brought into cultivation; in figuring this species, Icones, plate 1668, Baker noted that it was already grown in Europe and America.

C. gracilipes occupies a middle station, on the high mountains of northern Luzon. I described it, as Rosenstock did *D. genuflexa*, in ignorance or oversight of *Polypodium oyamense*, and was at first disposed to reduce it when I took note of that species. But I afterward collected it four times, and found it to be always distinguished by its extremely slender stipe and longer and narrower sori.

***Athyrium uncidens* (Rosenstock) Copel. n. comb.**

Dryopteris uncidens Rosenst., Fedde's Repert. 10 (1912):337.

Of this, we have a cotype, *Frau Bamler, No. 3*, and a more ample and more fully fruiting frond, *Keysser No. 179*. Every distinctive feature it has, marks it as an *Athyrium* (*Diplazium*, if one will), rather than a *Dryopteris*. For reasons not easy to guess, Brause shifted it from *Leptogramme* to *Lastraea*. I have not seen *Dryopteris stellato-pilosa* Brause, Bot. Jahrb. 56 (1920):96; the description of its roots—"Rhizoma . . . radices numerosas validas adpressas emittens,"—strongly suggests *Athyrium* (*Diplazium*), but the place in either genus will be established by a comparison of paleae.

***Blechnum Rosenstockii* Copel. sp. nov.**

Adest frons fertilis 45 cm. longa, vix 5 cm. lata, subcoriacea, parte inferiore 15 cm. longa angustissima rhachi gracile straminea paleis paucis stramineis ovatis acuminatis ciliato-dentatis 1.5–3 mm. longis praedita, pinnis late triangularibus 2–5 mm. longis basibus valde dilatatis superiorum confluentibus, parte superiore anguste lanceolata vix pinnata, pinnis inter se ca 6 mm. (costa ad costam) remotis, basibus dilatatis ala angusta et breve connexis, pinna quaque in parte mediale frondis e basi basiscopica dentem unam conspicuam emittente, apud baseos spatio breve sterilibus grosse serratis, deinde sporangiis omnino tectis, 2 mm. latis; indusio explanato angusto.

New Guinea: Bolan, alt. 2400–3000 m. Keysser II 70, 1912. Type in Herb. Univ. Calif., No. 391403.

I name and describe this incomplete specimen because of its exceptional interest, it being the first form known to me intermediate

between the body of the genus and the hitherto very isolated *Blechnum Fraseri*. That species, in typical form or in some variety, has been found on high mountains in Luzon, Borneo, Sumatra, and New Guinea, and in New Zealand. New Guinea can now be fixed upon, with much probability, as its native land.

***Stenochlaena Novae-Caledoniae* (Mett.) Underwood**

Franc No. 663, collected at Yakoné, Jan. 2, 1911.

The same number includes *S. Balansae* Fournier, collected at Bendia, in January, 1907. These seem to have been only the second collections of both species.

***Ithyaulon acuminatus* (Rosenstock) Copel., comb. nov.**

Dennstaedtia acuminata Ros., Hedw. 56 (1915):350.

The caudex and paleae were correctly described by Rosenstock, and show unmistakably the proper place of the plant. It not only resembles (*Saccoloma*) *Ithyaulon moluccanus*, as he noted, but is very near to being that species. The sori or indusia are shorter, but are still drawn down to a point at the base, as is typical of *Ithyaulon* but not of *Dennstaedtia*.

***Hypolepis Brooksiae* v. A. v. R.**

Bull. Jard. Buit. 28 (1918):29.

Our specimen received as this species, Winkler 109a, is sterile. But, whatever its sorus, I would rather place it in *Dennstaedtia*. Capt. van Alderwerelt noted its resemblance to *D. moluccana*, when publishing the species.

***Cheilanthopsis elongata* (Hooker) Copel. comb. nov.**

Woodsia elongata Hooker, Sp. Fil. 1 (1844):62, pl. 21c.

Cheilanthes straminea Brause, Hedw. 54 (1913):205.

Cheilanthopsis straminea Hieron., Notizbl. Berlin 7 (1921):408 by inference; Copeland, Univ. Calif. Publ. Bot., 16 (1929):95.

I do not believe that this species belongs in *Woodsia*, in which it was recognized as a foreign element by Hooker, nor that it is congeneric with *W. mollis*, which would make it be *Physematium elongatum* Trev. I have no doubt, however, as to the specific identity of the plant collected by Maire, without rhizomes, and Hooker's species of which also we have ample material, all similarly imperfect, including the collection by Edgeworth cited in the original publication.

Histiopteris integrifolia Copel.

Phil. Jour. Sci. 70 (1912):63.

Described from Sarawak, where it seems not to be rare. It comes in now from Sumatra, Batakerland, coll. by Winkler, s.n., in 1912, and received from Rosenstock as a variety of *H. incisa*. On this Sumatra specimen all compound or deeply divided portions of the frond are stalked, the pseudo-stipulate habit (of *H. incisa*) thus being entirely lost, as happens also in the Fijian *H. sinuata*. Some of the compound or divided parts of the frond are usually sessile on Borneo specimens, but all are certainly one species.

Hemipteris Werner Rosenstock.

Plate 51

In my treatise on the genera of Polypodiaceae, Univ. Calif. Publ. Bot., 16 (1929):92, I gave no place to *Hemipteris*, not having seen it; also I had overlooked a discrepancy in the generic and the specific descriptions. The former reads "soris . . . laciniarum marginem posteriorem solum occupantibus," which is in error and gives a wholly incorrect idea of the plant. The specific description is correct: "soris 4-5 in utroque latere laciniarum sitis," but, except the lowest, placed on the basiscopic side of the finer divisions, lacinulae or teeth; and these teeth are very short. The interruption of the sori is in this plant fairly consequent on the shape of the segments, the margin broken just enough not to bear the continuous sorus of *Pteris*. Hillebrand emphasized the fact that the shortness of the sori of *Schizostege Lydgatei* may not be explained in this way. The sori are necessarily restricted to the basiscopic side of the lacinulae or teeth, the acroscopic side being too short for a sorus. However, I am not disposed to reduce this plant to *Pteris*. It is too imperfectly known for positive judgment, but seems more similar to *Schizostege*. Using numbers to show the probable phylogeny of the genera, I give this number 242151, *Schizostege* becoming 242152. The pedate form, attested by Werner's pen sketch, indicates origin from such a fern as *Pteris tripartita*. It has not so far been possible to detect a group in *Pteris* ancestral to *Schizostege*. *Hemipteris* is represented by the original collection and by Schlechter No. 16944, from the Kani Mountains, alt. 1000 m.

***Oleandra pubescens* Copel. n. sp.**

Plate 52a

O. magnifica aspectu *O. musifoliae*, rhizomate ut videtur repente, 2–3 mm. crasso, radicoso, paleis castaneis ovatis 2–3 mm. longis appressis in vetustate sublaceratis dense obtecto; phyllopodiis approximatis non verticillatis, 3–4.5 cm. altis, validis, dense pubescentibus pube fulvo 1 mm. longo; stipite usque ad 12 cm. longo, costaque et sparsius fronde utraque facie pubescentibus; fronde 40 cm. longa, 3.5 cm. lata, deorsum valde attenuata, papyracea; venis inconspicuis, marginem prope vix 0.5 mm. inter se remotis; soris subcostalibus, permultis; indusio variabile, 1.5–1.7 mm. lato, persistente, pubescente.

Siam: Doi Chiang Dao, Eryl Smith No. 1072. Type in Herb. Univ. Calif., No. 227495.

Received as *O. Cumingii*, from which it is very different. In gross appearance it suggests *O. musifolia* and *O. Wallichii*, from both of which it differs in pubescence, long phyllopodia, and narrow base of frond.

***Oleandra gracilis* Copel. n. sp.**

Plate 52b

Rhizomate verosimiliter scandente, 1.5–2 mm. crasso, paleis tenuibus ferrugineis 5 mm. longis basi peltata vix dilatata 0.6 mm. lata fere integris apicem versus rhizomatis patentibus alibi appressis vestito; phyllopodiis 2–4.5 cm. longis, minute puberulis; stipite 5–10 mm. longo; fronde lineari-lanceolata, 15–20 cm. longa, 11–17 mm. lata, utrinque angustata, papyracea, costa et margine minute et sparse ciliatis, costa paleis paucis atrocastaneis lanceolato-ovatis 2 mm. longis inconspicuis praedita; soris inframedialibus, irregulariter uniseriatis, indusio 1 mm. lato.

New Guinea: Bolan, alt. 2400–3000 m., 1. Keysser No. 74 (†), 1912. Type in Herb. Univ. Calif., No. 391406.

Received from Rosenstock, without number, doubtfully determined as *Oleandra Whitmeei*, which is a larger plant, with hairy surfaces and margin, thinner fronds, much larger and more spreading paleae on the rhizome, and pale but conspicuous linear paleae 4–5 mm. long on the costa.

***Araiostegia* Copeland**

Phil. Jour. Sci. 34 (1927): 240

Araiostegia perdurans (Christ) Copel. n. comb.

Davallia perdurans Christ, Bull. Boiss. 6 (1898): 970.

Davallia parvipinnula Hayata Mater. Fl. Formosa (1911): 431.

Leucostegia parvipinnula Hayata, Icones Form. 4 (1914): 205, f. 139.

Araiostegia parvipinnula Copel., Phil. Jour. Sci. 34 (1927): 241.

Araiostegia perdurans, of which ample material is now in hand, was unknown to me under its proper name when I shared the responsibility for *Leucostegia parvipinnula* (*loc. cit.* p. 207). It was found in Formosa by Faurie also, and distributed by Rosenstock, Fil. Formosanae No. 36, under the correct specific name.

***Araiostegia dareiformis* (Hooker) Copel. n. comb.**

Polypodium dareaeforme Hooker, 2nd Century of Ferns (1860), pl. XXIV.

This was described as exindusiate; Beddome, Ferns Brit. India and Ceylon (1892): 52, stated that he found it constantly so; and this is surely true of a fine specimen in hand, collected by G. Mann in the "Khasi Hills, alt. 4000 ft.," in July, 1889. Nevertheless, I refer it with entire confidence to *Araiostegia*. Its resemblance and probable affinity to *A. Clarkei* has been noted repeatedly, e.g., by Beddome, who once, Ferns, Brit. Ind., Suppl. (1876): 4, tried to combine them. The articulation of the stipe seems to be functional.

A considerable range in the development, or reduction, of the indusium is already known in this genus; it is notably small in *A. hymenophylloides*; and I am not at all tempted to set up a new genus for this and the following species in celebration of its disappearance, even though accompanied in both cases by conservation of the articulate stipe. It is, however, worthy of note that these characteristics of *Polypodium* are found in species which have the characteristic habitat of that genus.

***Araiostegia gymnocarpa* Copel. sp. nov.**

Araiostegia epiphytica, rhizomate 3–4 mm. crasso paleis castaneo-fuscis lanceolatis apicibus in caudas pallidas valde protensis persistentibus vestito; stipite gracile 5 cm. alto stamineo-castanescente, glabrescente, ad rhizoma articulado; fronde deltoidea, 6–8 cm. alta, 4–6 cm. lata, 3–4-pinnatifida, rhachibus microscopice et decidue squamuliferis; pinnis inferioribus deltoideo-ovatis, superioribus oblique lanceolatis, rhachibus sursum anguste alatis; pinnulis ad costas alas alis inclusis haud 1 mm. latis pinnatifidis, segmentis ad basin frondis iterum furcatis vel pinnatifidis, ultimis vix 1 mm. latis, obtusis vel acutis, monophlebiis; soris ad furcas ultimas venarum insertis, orbicularibus, latitudinem totam laminae complentibus, etenim in juventate sporangiarum exindusiatis.

Siam: Doi Angka, alt. 2100 m., 1. Kerr No. 6318, Herb. Univ. Calif. No. 237221, type. Also, Doi Sodep, Chiangmai, 1. Eryl Smith No. 1276.

***Araiostegia parva* Copel. sp. nov.**

Plate 53a

Rhizomate valido, repente, paleis membranaceis castaneis acuminatis (nec caudatis) 6 mm. longis basi peltata 2 mm. latis margine minute denticulatis vel subintegris dense vestito; stipitibus approximatis, supra basin vestigialiter articulatis, fuscis vel castaneis, nudis, nitidis, facie ventrali sulcatis, aliter teretis, normalibus gracilibus 4 cm. altis, aphyllis deorsum usque ad 1 mm. crassis sursum gracile-scentibus usque prope laminam solummodo 0.2 mm. crassis et ibidem (in herbario) recurvis; fronde 4 cm. longo, 2 cm. lata, bi-tri-pinnata costis pinnarum alatis, glabra, pinnis paucis, sessilibus, pinnulis vel segmentis 0.25 mm. latis, lanceolatis, paucis, prope basin unisoriatis, indusio transversim oblongo, anguste affixo, quam lamina multo latiore.

Sikkim, alt. 8000–12,000 ped., 1. J. D. Hooker. Type in Herb. Univ. Calif., No. 401269, from the Lemmon Herbarium as *Acrophorus Hookeri* Moore.

The very remarkable fern figured as plate 5, *a*, is found on sheet No. 50262 of the U. S. National Herbarium, in company with *Trichomanes bipunctatum*, to which the label of the sheet applies. The largest of its two fronds is 8 mm. long and 4 mm. wide. In spite of the suspicion that it is a monstrosity produced perhaps by the eating of the fronds by some animal, I prepared to describe it as a new species, before finding in the Lemmon Herbarium the fern purporting to be *Acrophorus Hookeri*, a symmetrical, apparently normal frond, with the dimensions stated above, attached to its rhizome, and with some of the enlarged leafless stipes characteristic of the specimen photographed. They certainly represent the same species.

As to *Acrophorus Hookeri*, the name was given by Moore, but the plant must be typified as first described and figured by Beddome, Ferns. Brit. India, pl. 95. This is not *A. dareiforme*; it may be *A. Clarkei*, which in such case becomes a synonym. It is not the fern here described, although they may have been mixed in or after collecting. *A. parva* is related rather to *A. perdurans*, as shown by the sessile pinnae. It is not merely smaller than any previously described species; it is very much more delicate.

None having been compiled hitherto, the following key to species of *Araiostegia* should be useful. The species in hand are indicated by asterisks.

Paleae conspicuously attenuate

Indusium evident

Lamina commonly over 40 cm. long 1. *A. hymenophyllodes**

Lamina hardly 10 cm. long 2. *A. pulcherrima*

Indusium not evident

Frond quinquepinnatifid at base 3. *A. dareiforme**

Frond at most quadripinnatifid 4. *A. gymnocarpa**

Paleae obtuse to acuminate, but not caudate

Pinnae stalked

Segments obtuse to acute

Teeth obtuse or hardly acute 5. *A. yunnanensis**

Teeth evidently acute

Frond glabrous

Fond narrowly deltoid 6. *A. pulchra**

[illegible]

deep green 8. *A. athamantica*

Frond more or less puberulent 9. *A. multidentata*

Segments conspicuously acuminate 10. **A. pseudocystopteris***

Pinnae sessile

Fronde more than 1 dm. tall 11. *A. perdurans**

Fond less than 1 dm. tall 12. *A. parva**

Of the species not seen, *A. pulcherrima* is distinct if correctly described. Of *A. pulchra*, we have a number of specimens, all apparently correctly named, but not uniform. In view of its lack of uniformity, the distinctive peculiarities of *A. Clarkei*, *A. athamantica*, and *A. multidentata*, while known from descriptions only, are not convincing.

Davallodes novoguineense (Rosenstock) Copel. comb. nov.

Davallia viscidula var. *novoguineensis* Ros., Fedde's Repert., 12 (1913):526.

The probability already expressed, Phil. Jour. Sci. 34 (1927) :249, that this is a distinct species, is sustained by examination of a specimen received from Dr. Rosenstock. The difference in paleae is inconsiderable, those of *D. viscidulum* showing a trace of cilia and those of *D. novoguineense* being but sparingly ciliate; but the indusia are quite different in shape. Also, the frond is more naked, and narrower in outline, the pinnules are relatively broad, and their segments are less incised.

Humata Wernerii Copel. sp. nov.

· Plate 53b

Rhizomate 2 mm. crasso, late repente, paleis castaneis acutis 2-2.5 mm. longis basi peltata 0.5-1 mm. latis acutis plerisque patentibus vestito; stipite ca 12 cm. alto, gracile, nudo; fronde fere 15 cm. alta, deltoidea, bipinnata, acuminata, chartacea, axibus squamulis minutis obscuris praeditis; frondis fertilis pinnis infimis stipitulatis, 7 cm. longis, basi 3-4 cm. latis, valde acuminatis, pinnulis infimis auctis, sequentibus lanceolatis, 1.5-2 cm. longis, basi obliquis, incisus dentibus obtusis brevibus, cum soro uno in sinu quoque, indusio quam alto latiore, apice submarginale; frondis sterilis pinnulis plerisque integris.

New Guinea: Gelu, alt. 1000 m. 1. Werner No. 17a, July, 1907.

Received as *H. vestita*, which has different paleae on rhizome, stipe and frond. The affinity to *H. alpina* is closer, but that species has larger paleae on the rhizome, stouter stipes and broader and more cut pinnules.

***Humata intermedia* C. Chr.**

Luzon: Bontoc, 1. Vanoverbergh No. 275, April, 1910. Already known from Borneo, Perak, and Sumatra.

***Scyphularia dorsalis* Copel. sp. nov.**

Plate 54a

Rhizomate ramoso late repente, 2-3 mm. crasso; paleis nigro-castaneis valde acicularibus subciliatis ca. 4 mm. longis vestito; stipitibus remotis, gracillimis, 3-4 cm. longis; fronde trifoliolata, foliola mediale stipitulata 4-5 cm. longa, 7-8 mm. lata, acuminata, basi abrupte cuneata, subcoriacea, margine sterile serrata vel incisoserrata, fertile dentata et irregulariter subincisa, foliolis lateralibus paullo minoribus; indusio, 1.5-2 mm. longo, parte apicale libera rotundata plerumque a margine remota.

New Guinea: Sattelberg, 1. Bamlar, No. 34, anno 1909. Type in Herb. Univ. Calif., No. 391612.

This is received from Dr. Rosenstock as *Davallia pentaphylla* Bl., v. *incisa* Ros. Its most striking feature is the remoteness of the sori from the margin. Because this feature is not mentioned in the publication of that variety, Hedwigia 56 (1915):351, and this collection is not cited there, although of earlier date than the one upon which the variety was based, it seems safer to name and describe this plant *de novo* rather than to raise the variety to specific rank. It seems to be a thoroughly distinct species, but nearer to both *S. sinuosa* and *S. pycnophylla* than to *S. pentaphylla*. The remoteness of sori from the margin is inconstant (conspicuous in 3 of 4 fertile fronds in hand), and is sometimes to be detected on *S. pentaphylla*; but the slender stipe, small size, thinner texture, and free, rounded apices of the indusia distinguish the species more than sufficiently.

***Scyphularia tannensis* Copel. sp. nov.**

Plate 54b

Rhizomate ca. 4 mm. crasso, lignoso, paleis basi 1-1.5 mm. lata castanea peltatis, deinde abrupte in setam atram 8-10 mm. longam contractis densissime obsito; stipite valido, castaneo, frondis sterilis 5 cm., fertilis 7 cm. alto; fronde deltoidea, brunnea, rigide chartacea, pinnata, sterile 10 cm. longa, 8 cm. lata, pinnis lanceolatis, 1 cm. latis, sursum minute serrulatis, lateralibus triparibus infimis fere ad basin furcatis, fronde fertile 12 cm. longa, 14 cm. lata, conforme, pinnis 7 mm. latis, leviter crenatis; soris ad dentes positus, indusio 2 mm. longo, 1.4-1.8 mm. lato, marginem vix attingente.

Tanna: Lenakel, alt. 200 m., "common in rain forest," S. F. Kajewski No. 102, March 5, 1928.

There have been reported from *Aneityum S. pentaphylla* by Moore and *S. pycnophylla* by Kuhn. The species here described bears little resemblance to the latter, which is characterized by deeply incised pinnae. From *S. pentaphylla* it is distinguished by stouter rhizome, longer and blacker awns on the paleae, comparatively entire margin, and broader and shorter indusia. The serrateness of the margin of sterile pinnae is in most places merely indicated by minute incisions, like those of *Microterus*.

***Polypodium pleurogrammoides* Ros.**

Fedde's Repert. 5 (1908):42

This species combines the ordinary frond-form of a *Grammitis* with the sori of the species whose latest name is *Nematopteris interrupta* (Baker) C. Chr., Dansk Bot. Arkiv, 6 (1929):31, pl. 4, figs. 8-12. Unless the attenuate base be a sufficient ground for separation, it is congeneric with the latter species. If I were at the moment naming it with a new combination it would be in *Grammitis*. The affinity to *Scleroglossum* seems almost sure.

This genus, *Scleroglossum*, was set up on the basis of distinctions from (*Pleurogramme*) *Cochlidium* which have never seemed to me sufficient, although I have used the name. Before publishing *Pleurogramme intermedia*, I consulted American material of *C. seminudum* and decided that no morphological differences would justify a generic distinction of the oriental species; and I have been glad of late to join Goebel in this opinion. Christensen, Dansk Bot. Arkiv, 6 (1929):16, contributes stellate (more properly *clustered*) hairs as an added peculiarity of *Scleroglossum*; these may not always be detected. The tangible difference comes down to the immersion of the sori of *Scleroglossum* in two grooves, and discontinuity of distribution. The latter is important exactly to the extent to which it indicates independent phylogeny. *Didymochlaena* and *Cyclopeltis* share the combined range of *Cochlidium* and *Scleroglossum*, and it is the specific, not generic identity of their American and Malayan representatives which raises surprise or question.

When, however, the discontinuity of occurrence is supported by evidence of independent origin in the two or several regions, it becomes stronger than any ordinary but minor structural difference as evidence of generic distinction; and we now have this evidence. The affinity, necessarily based on common origin, of *Cochlidium* to *Xiphopteris*,

and thus to American species of *Grammitis*, has been established sufficiently—see Christensen, *loc. cit.*, p. 32; Goebel, *Flora*, 117 (1924) :91, *et seq.* In gross characters, *Polypodium pleurogrammoides* shows convincing resemblance to both *Scleroglossum* and *Grammitis*. And here Christensen's clustered hairs return to our attention. I am less impressed than was Rosenstock by their value in showing affinity to *Polypodium jagorianum* as a particular species, for they are more like the hairs of other *Grammitis* species more like this in texture also. It is as a peculiarity running from *Grammitis* through this species to *Scleroglossum* that they are particularly interesting.

The recognition of this species as a link between *Scleroglossum* and Old World species of *Grammitis* explains the geographical isolation of *Scleroglossum* and *Cochlidium*, and compels their recognition as generic entities, with no alternative except their return to *Grammitis* or *Polypodium*. Regardless of personal judgment as to the importance of the structural distinctions, it is simply impossible to regard them as constituting a genus. In my enumeration, *Scleroglossum* becomes No. 42322 and *Cochlidium* No. 42328. As remarked before, it is only when I understand with some confidence the origin of a genus that I get real confidence in its generic status.

Loxogramme parallela Copel.

New Guinea: Bolan, alt. 2400–3800 m., Keysser, Nos. 40, 81, 1912.

Received with this name from Dr. Rosenstock, but I find no published record. These specimens are essentially identical with the large form reported from Mount Matutum, Mindanao, *Phil. Jour. Sci.*, 38 (1929) :153.

Polypodium bolanicum (Rosenstock) Copel. comb. nov.

Polypodium solidum (Kzt.) Mett., var. *bolanica* Rosenstock, Fedde's Repert. 12 (1913) :177.

Besides the several distinctions mentioned by Rosenstock, the fronds are comparatively long-stipitate. The most positive character is provided by the larger, comparatively pale paleae.

Polypodium taxodioides Baker

P. taxodioides var. *ericoides* Rosenst.

Keysser No. 77, the type collection of the variety, is, in all respects noted, within the range of variation of Kinabalu specimens collected by Mrs. Clemens.

***Prosaptia Rosenstockii* Copel. sp. nov.**

Rhizomate breve, paleis lanceolatis atrocastaneis ca. 3 cm. longis ciliatis vestito; stipitibus confertis, inarticulatis, brevibus, pilis 0.4–0.6 mm. longis haud dense vestitis; fronde usque ad 45 cm. longa, ca. 33 mm. lata, lateribus longe parallelis, utrinque acuminata, ad alam vix 1 mm. latam pectinata, costa et lamina inferne minute setulosis setis atropurpureis, subcoriacea; segmentis proximis, costam versus 5 mm. latis, deinde ad apices obtusas angustatis; soris (speciminorum) ad apices segmentorum restrictis et paucis vel solitariis, 2 mm. longis, cum margine conterminalibus.

New Guinea; ins. Rook, alt. 250 m., 1. Bamler, No. 23 R., Feb., 1912. Type in Herb. Univ. Calif., No. 391612.

Received as "*Davallia contigua* var. *ancestralis*." *Prosaptia ancestralis* has longer stipes, densely and conspicuously clothed with hairs 1 mm. long, wider, thinner, comparatively naked fronds, segments farther apart, distinctly intramarginal sori, and paleae up to 7 mm. long on the rhizome. *P. Rosenstockii* is intermediate in dissection between the two common species, *P. contigua* and *P. alata*, but nearer, on the whole, to *P. contigua*.

***Prosaptia davalliacea* (Mueller et Baker) Copel. comb. nov.**

Polypodium davalliaceum Mueller et Baker, Jour. of Bot. 28 (1890):108.

Polypodium monocarpum Rosenstock, Fedde's Repert., 12 (1913):178–f.

As to the identity of these plants, I am, like Brause, Engler's Bot. Jahrb., 56 (1920):190, somewhat less than sure, not having an authentic specimen of the former. The latter is very closely related to *Prosaptia linearis* Copel., Phil. Jour. Sci., 4C (1909):115, and with that Luzon species constitutes a group of very distinct appearance. *P. monocarpum* seems to be distinguishable by somewhat broader fronds and pinnae, the tip of the fertile pinna still more conspicuously drawn out, and with much paler paleae on the rhizome.

***Prosaptia Engleriana* (Brause) comb. nov.**

Davallia Engleriana Brause, Engler's Jahrb. 49 (1912): 27, f. 1, H.

Nearer to *P. alata* than to *P. contigua*.

As late as 1920, Brause has continued to leave the species of this genus in either *Davallia*, where he describes *D. Ledermanni*, or in *Polypodium*, where he leaves *P. monocarpum*, without evident prejudice in either direction.

***Cyclophorus micraster* Copel. sp. nov.**

C. angustato affinis, rhizomate late repente, fere 2 mm. crasso, durissimo, nigro et basibus nigris persistentibus imbricatis palearum tecto, paleis primo e base appressa usque ad 2 mm. longa fere 1 mm. lata in apicem linearem albido-fulvam patentem 4-5 mm. longam deciduam angustatis; frondibus dimorphis, sterilis stipite ca. 2 cm. longo brunneo, nudo, deorsum tereto, ad phyllopodium validum 1.5 mm. altum articulado, sursum subalato, fertilis ca. 6 cm. longo, fere ad basin angulato; lamina sterile elliptica 8-11 cm. longa, 3-4 cm. lata, basi subcuneata, apice obtusa, rigide coriacea, siccitate brunnea, superne glabrescente hydathodis carente, inferne pilis stellatis $1/7$ mm. latis persistentibus et sub illis sparsim indumento amorpho vestita, fertile lineare, medio 10-11 mm. lata, deorsum sensim angustata, margine deflexa cartilaginea in alam stipitis transeunte, inferne pilis stellatis fulvis permultis parvis et aliis majoribus paucis nigrescentibus vestita; soris utrinque uniseriatis, margini approximatis, late oblongis, ca. 5 mm. longis, immersis et superne conspicuis.

Malay peninsula, Kelantan, Batu Bow, Sungei Keteh, 1. Md. Nur, No. 12060, Feb. 11, 1924. Type in Herb. Univ. Calif., No. 234680.

Nearly related to *C. angustatus*, but with broader and less pointed sterile fronds, narrow fertile fronds without a broader sterile basal portion, and with decidedly smaller stellate hairs. The few larger dark paleae intergrade with the smaller ones; they may be more deciduous and have been lost from the sterile fronds in hand. *C. angustatus* is a fairly uniform species in this region. There is a chance to doubt its being the typical plant of this name, of which I know no report from the type locality, Tranquebar, later than that of Swartz.

***Dictymia Mettenii* Copel.**

Univ. Calif. Publ. Bot., 16 (1929):114.

Polypodium Mettenii Copel., Univ. Calif. Publ. Bot., 14 (1929):368.

Polypodium marginatum Baker, Syn. Fil., p. 513, nec Houtt., nec Moore.

In describing this plant, I overlooked Baker's earlier description of what is quite certainly the same species. By good luck, this did not result in a useless synonym, as Baker's specific name was not available.

Franc No. 470, as distributed, turns out to be in part this species and in part Mettenius' first form, which still goes as *D. Brownii*.

Selliguea féeioides Copel.

Bishop Mus. Bull. 59 (1929):17.

Aneityum. Kajewski No. 325, and probably No. 165.

This (No. 325) has the characteristic paleae, but not the conspicuous minor venation of the Fiji specimens by which the species is typified. The conspicuousness of this venation, or its opposite, is perhaps artificial.

Lecanopteris lomarioides Copel.

Univ. Calif. Publ. Bot. 16 (1929):123.

Polypodium lomarioides (J. Sm.) Kze., in Mett. Polypodium, p. 102.

This species was described from a Philippine collection by Cuming. In *Species Filicum* its range is given as "Malaya, Formosa, Philippines," and this is copied by others, who would certainly not follow the same authority in treating *Lecanopteris carnosa* as "an abnormal form" of it. Van Alderwerelt, *Malayan Ferns*, p. 623, followed Baker in describing it with a "rhizome forming a thick, wide-spreading crust," which may be true of all plants responsible for the citation of this species from "Malaya." The original description read "rhizoma repens." It is in fact not very unlike that of *L. sinuosa*. The species seems to be rare in the Philippines, for I have but two specimens, Cuming No. 242 (a cotype) and McGregor, Bu. Sci. No. 14275, from Nueva Vizcaya.

Lecanopteris crustacea Copel. sp. nov.

Rhizomate cavernoso intricato crustam latam plus minus 1 cm. profundam efformante, squamis peltatis orbicularibus ca. 0.7 mm. latis centro nigro excepto albidis vestito; stipite (speciminorum) ca. 6 cm. alto; fronde 10-15 cm. alta, ovata, subpinnata, glabra (in herbario), papyracea; segmentis fr. sterilis paucis, adnatis et ala connexis, 3-5 cm. longis, 10-15 mm. latis, integris, apice truncato-rotundatis, segmento apicale conforme; venis inconspicuis; frondis fertilis rhachi sursum angustius alata, segmentis inferioribus non connexis (pinnis), 3-5 mm. latis; soris medialibus, oblongis, costae parallelis, vix 1 mm. latis, 1.2-3.0 mm. longis, leviter et anguste circumvallatis, immersis et facie superiore frondis sat conspicuis.

Sumatra, 1. Burchard No. 158. Type in Herb. Univ. Calif., No. 391610.

Received as *Polypodium lomarioides* Kze., which, as just explained, has a very different rhizome. This seems to be the *P. lomarioides* reported from "Malaya," judging by the character of the rhizome.

In that case, my specimens are probably unusually small, although fruiting freely.

I am not equally confident of its distinctness from *L. sarcopus* (*Polypodium sarcopum* Teijsm and Binn., Nat. Tijds. Ned. Ind., 29 [1867]:241), usually cited as of De Vr. and Teijsm., the collectors. Collected under this name, as *P. myrmecophilum* Christ, and perhaps as *P. Sauvinierei* Baker, in Celebes, it is ascribed to China on the insufficient evidence of a frond without the rhizome. It was first described, and is figured by Christ, as having round sori. Christ's very full description, Ann. Jard. Bot. Buit., 15 (1898):158, treats of a deep and bulky rhizome mass, instead of the flat one here described, and by some authors ascribed in error to *L. lomarioides*.

***Dendroconche Kingii* Copel. sp. nov.**

Rhizomate scandente, 3 mm. crasso, squamulis fuscis ovatis appressis sparis vestito, radices multas adhaerentes et absorbentes densissime pilosas foliis omnino obtectas gerente; frondibus sessilibus, imbricatis, aliis orbicularibus, aliis panduriformibus cum basibus orbicularibus, cordatis, integris, 5-10 cm. latis, papyraceis, venatione utraque facie conspicua; parte apicale frondium protractarum aut sterile aut fertile, lanceolata, usque ad 20 cm. longa, medio 4 cm. lata, deorsum angustata (ibidem 1-2 cm. lata), acuta; soris irregulariter pluriseriatis.

Papua. King No. 387.

In the original description of this genus, I treated it as an offshoot of *Polypodium musifolium*, which was perhaps not quite correct. At any rate, it is more immediately related to *Microsorium linguaeforme*, as stated in my general discussion of the Oriental genera, Univ. Calif. Publ. Bot., 16 (1929):116. The fern here described is intermediate between *D. Annabellae* and this ancestral representative of the phyletic group, but sufficiently advanced along the line of evolution to comply with the published generic diagnosis, except that the terminal part of the frond is broader than linear and not always fertile. I have held it undescribed for years, thinking that it might prove a juvenile plant of *D. Annabellae*, which it may be. However, it is as large as that species is known to be, and shows no signs of being juvenile, except as it does represent a step in the assumed evolution of *D. Annabellae*.

EXPLANATION OF PLATES

All illustrations are from photographs by W. G. Matthews.

The scale of each illustration is indicated by the centimeter scale photographed with it.

PLATE 49

a, *Lycopodium Selago* L. *Clemens* No. 10601.

b, *Asplenium Parksii*. Type.



PLATE 50

Cyathea Setchellii. Type.



PLATE 51

Hemipteris Wernerii Rosenstock. Type collection.



PLATE 52

a, *Oleandra pubescens*. Type.

b, *O. gracilis*. Type.

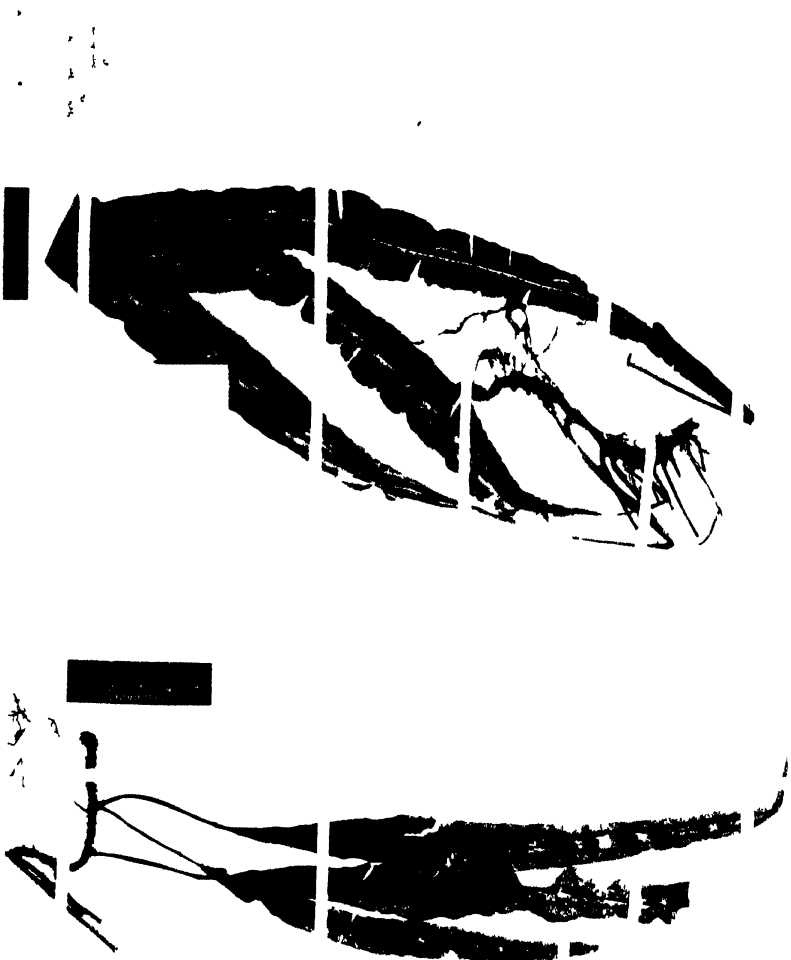


PLATE 53

a, *Araiostegia parva*. U. S. Nat. Herb. specimen.

b, *Humata Wernerii*. Type.

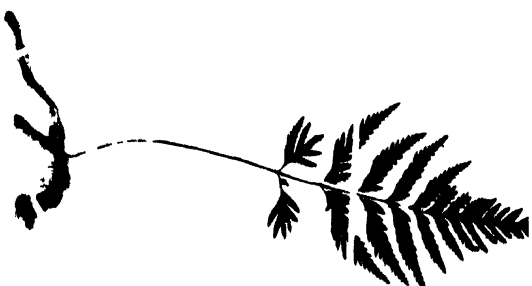


PLATE 54

a, *Scyphularia dorsalis*. Type.

b, *S. tannensis*. Type.

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